AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 10, No. 11 WEEKLY. | NEW YORK, MARCH 12, 1887. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

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For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Iron Against Steel.

MASTER MECHANICS EXPRESS THEIR VIEWS ABOUT IRON AND STEEL FOR LOCOMOTIVE CRANK-PINS, AXLES, SLIDES AND PISTON-RODS.

We continue, from last week, our letters from superintendents of motive power and master mechanics, giving their opinions and experience about iron and steel for locomotive crank-pins, axles, slides and piston-rods. We also present cuts of the shapes of crank-pins used on some railroads. We have expressions of opinion on this subject from about seventy railroads, most of them favoring iron for crank-pins.

NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

I prefer steel to iron for crank-pins, piston, main and side rods; also for driving axles. We use Krupp steel for pins and rods, and Otis steel for axles. We run the pins six years, and then remove them. Would as soon think of going back to iron tire in place of steel as to go back to iron for crank-pins, rods or axles.

JOHN HENNEY, JR.,
Supt. Motive Power.

SAN FRANCISCO AND NORTH PACIFIC RAILROAD.

In answer to your inquiry concerning the re-adoption of wrought-iron for crank-pins, axles, slides, and piston-rods, I must say that our success with wrought-iron for the purposes mentioned has been so satisfactory that we have never discarded it.

E. REYNOLDS,
Master Mechanic.

FLORIDA RAILWAY AND NAVIGATION COMPANY.

I much prefer iron for rods and crank-pins, steel for guides and axles. I would use iron for axles, but the difficulty with which they are examined prevents the warning which iron gives from being taken advantage of.

My experience has been that steel when it starts a crack goes all the way through very rapidly, while iron usually breaks through one bundle of fibers and is held by the next for some time.

While in charge of the test department of the N. L. E. & W. R. R. I noticed that the softest steel, even when tested by the method used there (bending back and forth, the bending being confined to 6″ of the bar), invariably broke through completely, while wrought-iron would break through the outer bundle of fibers, leaving at least 75 per cent. of the bar still holding.

L. S. RANDOLPH,
Master of Machinery.

WESTERN RAILWAY OF ALABAMA.

We have discarded steel for the purposes mentioned in the articles, on account of the trouble caused by continual heating and several breaking. In fact, all the crank-pins that have broken and come under my observation during the past 25 years of my railroad experience have been about 75 per cent. steel. I use the best quality hammered wrought-iron for piston-rods, crank-pins, and driving axles, and all of which I find give perfect satisfaction. I never case-harden my iron. I use cast-iron for slides, which I also find gives more satisfaction than anything else I have used for this purpose.

JAS. E. WORSWICK,
Master Mechanic.

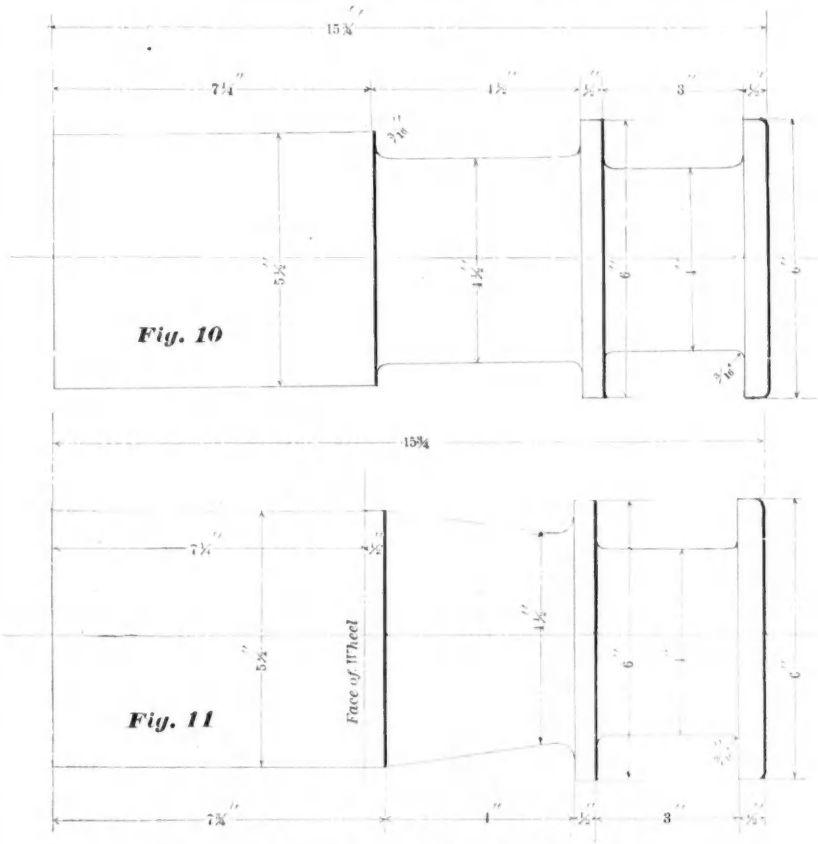


Fig. 10

Fig. 11

STEEL CRANK-PINS FOR PASSENGER ENGINES—SEVENTEEN-INCH CYLINDERS. RICHMOND & ALLEGHENY RAILROAD.

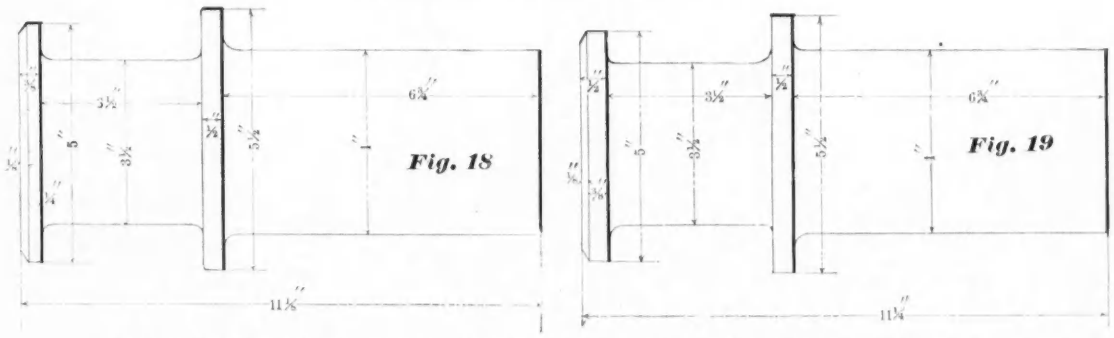


Fig. 18

Fig. 19

IRON CRANK-PINS FOR CONSOLIDATION ENGINES—TWENTY-INCH CYLINDERS. ERIE RAILROAD.

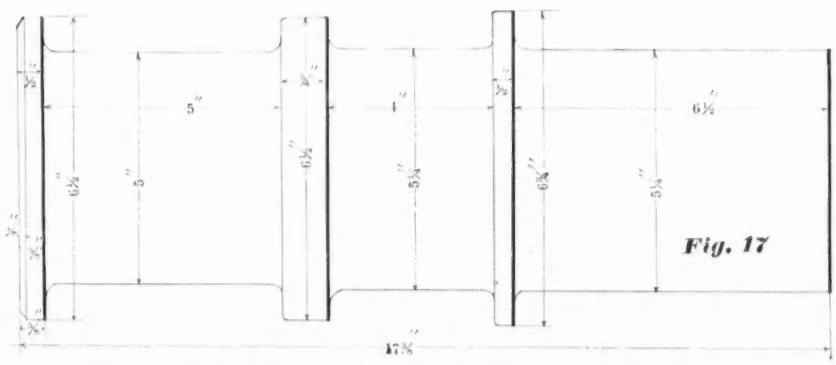


Fig. 17

STEEL MAIN CRANK-PIN FOR CONSOLIDATION ENGINES. ERIE RAILROAD.

GEORGIA RAILROAD.

We have been using steel driving axles, crank-pins, piston-rods and slides for some time, and propose to continue doing so.

We use only steel which has an established reputation for reliability and uniformity, and to this fact we believe our success in its use is in a large measure due.

My preference for crank-pins and slides is case-hardened iron, and my only reason for not using case-hardened iron exclusively for these parts is want of the necessary plant to do the work economically and quickly, and as steel does so well we do not think the advantages gained would warrant us in going to the expense of introducing the necessary plant at present. We have several engines fitted with case-hardened iron crank-pins and slides, some of which we ordered with the engines, and others we fitted up ourselves, and they give excellent satisfaction in every respect.

JOHN S. COOK,
Master Mechanic.

GALVESTON, SABINE AND ST. LOUIS RAILROAD.

With my present experience I prefer steel for driving-wheel axles, crank-pins, slides and piston-rods, as a matter of general economy and prudence.

D. D. PINKHAM,
Master Mechanic.

NORFOLK AND WESTERN RAILROAD.

We use steel to a great extent on very many of the parts of our locomotives, namely, boiler, fire-box, crank-pins, guide bars, and a few other small items. I am frank to say that our experience has been very successful with steel for these purposes. If the metal is well manufactured and strictly homogeneous I should prefer it to iron on account of its increased strength, yet if the metal is irregular we should not consider it as safe as a first-class article of iron. The chances, we believe, in the manufacture of both are about equal as to making the metal perfect, so that, all things considered, and so far as our experience goes at present, we feel safer with the use of steel for the parts above mentioned than iron. We do not use steel driving axles, for several reasons. We make them ourselves out of a very good quality of wrought-iron scrap, and they are quite large enough to stand any service that may be required of them.

S. B. HAUPT,
Supt. Motive Power.

CALIFORNIA SOUTHERN ROAD.

I am in favor of case-hardened iron for crank-pins and slides; for valve-stems and piston-rods, steel; driving axles, wrought-iron.

J. H. Setchel, Superintendent Brooks Locomotive Works, has probably had more experience and would be best authority on this subject that I know of.

C. DANIEL,
Master Mechanic.

COLORADO MIDLAND RAILWAY.

In reply to your favor in regard to the re-adoption of iron for locomotive crank-pins, axles, slides and piston-rods, I very much prefer steel for these parts of the locomotive, and I see no reason for discarding it and substituting iron.

WM. FULLER,
Supt. Machinery.

HOUSTON, EAST AND WEST TEXAS RAILROAD.

The question of iron or steel for crank-pins, axles and piston-rods, seems to require a great deal of discussion among the mechanics both of this country and England.

It seems singular that we differ so much in our ideas of iron and steel, different ideas being held by different master mechanics, one meeting with difficulties in iron and another with difficulties in steel.

I have had thirty years' experience in the machinery department of railroads, and

have been a locomotive runner, and also a machinist, and for the last twenty years I have been foreman, and am now master mechanic; and I must say I have not encountered the difficulties met with by others in the use of steel.

I am using all steel on crank-pins, piston-rods, axles and boilers, and I have made up my mind that steel is just the thing; and to illustrate I will give you some idea of steel.

My road is three foot gauge, and the largest engines we use have cylinders 13 by 18, and are eight-wheelers. Then there are moguls that are 12 by 16. Our road is hilly, and we pull twenty-five and thirty loads. I make this digression that you may see that our engines pull just as hard as any standard gauge. Now take the 13 by 18 engines; they have made 48,000 miles, and their crank-pins are not worn more than $\frac{1}{32}''$. The axles also are only $\frac{1}{32}''$ worn. I have replaced the driving brasses, but have not touched the boilers. The piston-rods are worn only $\frac{1}{32}$ of an inch.

The mogul engines have made over 100,000 miles, and I have never changed a crank-pin or axle, and the boilers are yet good. Out of four of these engines there is not an axle nor a pin that wants to be removed, and I have never had one to break.

Now I find that my iron used for same parts of an engine bears no comparison to the steel.

Perhaps, if parties would take a little more pains in lining up their engines, and keep them in tram, they would find better results with less complaint. For my part, I am decidedly in favor of steel, and shall continue to use it as long as I get the good results that I have already got.

Steel boilers should be handled with care. They should not have cold water run in them for at least three hours after they are blown out; then the plugs or hand-hole plates should be opened, and cold water run through them before they are filled up. It would be still better to use hot water where it can be had. With such care, I will guarantee success for a steel boiler.

E. A. Campbell,
Supt. Motive Power and Machinery.

Chicago and Alton Railroad.

Your favor at hand, inquiring my opinion as to the relative uses of steel and iron for various purposes.

I do not care to get into any controversy, or have my name mixed up in any manner with the question of the merits of steel or iron for the different purposes for which they are used. Each has its proper place.

We have used mild steel and iron for boiler and fire-box purposes. My experience leads me to employ steel as preferable for this purpose.

For crank-pins, iron; for axles (driving axles especially), steel, for the reason that it will stand a greater torsional strain.

I prefer wrought-iron, case-hardened, for guides, and for piston-rods well worked iron.

Wm. Wilson,
Supt. Machinery.

Cleveland, Lorain and Wheeling Railroad.

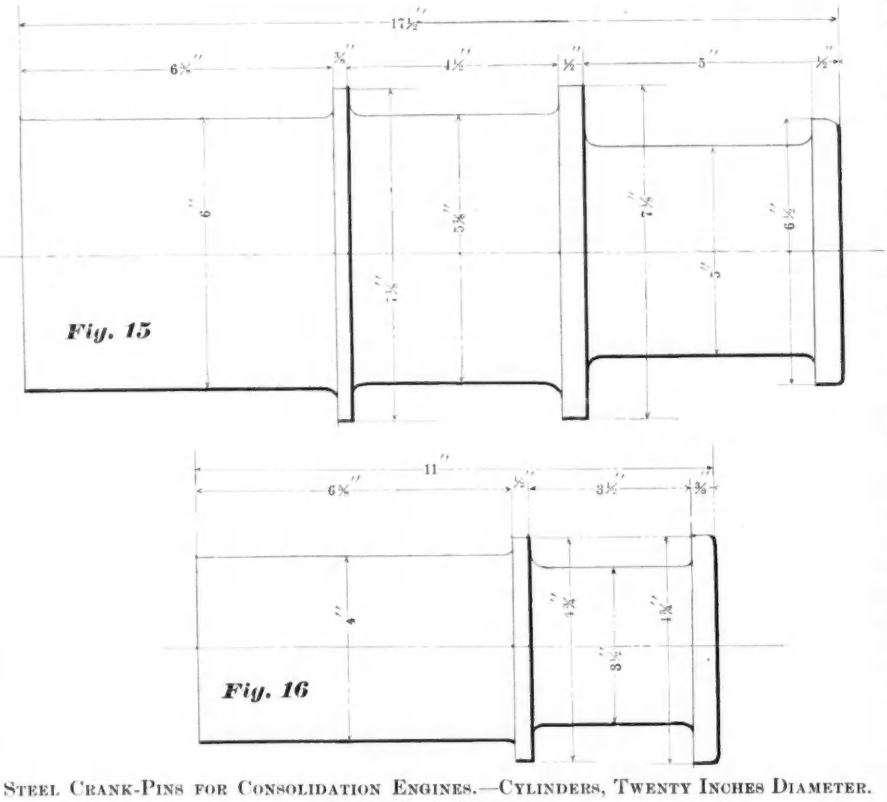
My experience in the use of steel for crank-pins has not been satisfactory—the greatest trouble I find they will break off without giving any warning. I have known pins that have not run over four years to break off, and in one instance a pin broke that had run only fifteen months. I will give you an instance of one engine running passenger train, making 226 miles daily, that broke two pins inside of ten days. When the engine broke the first pin, which was a main one, she broke the side rod. I repaired the engine as soon as possible, and before the engine ran a week she broke the main pin on the opposite side, and was brought to the shop for repairs again. I then pushed all the pins out with the exception of the one I put in when the engine first broke down. The two crank-pins looked perfectly solid when in the wheel, but when I took them out I found them both cracked, and in consequence had to throw them in the scrap pile, and put in new pins. These pins had been in about 4½ years, which I consider a short time for crank-pins to fail. I have engines on the road to-day that have been running for the past fourteen years with iron crank-pins and no signs of breaking yet; so in all I think it a good idea to return to iron crank-pins; I know with my experience they have given far better satisfaction than steel pins.

In regard to steel axles, I have used but eight truck axles, and they are all broken but one, and if I knew where that one was I would take it out. I am watching for it daily, expecting to hear of its being broken.

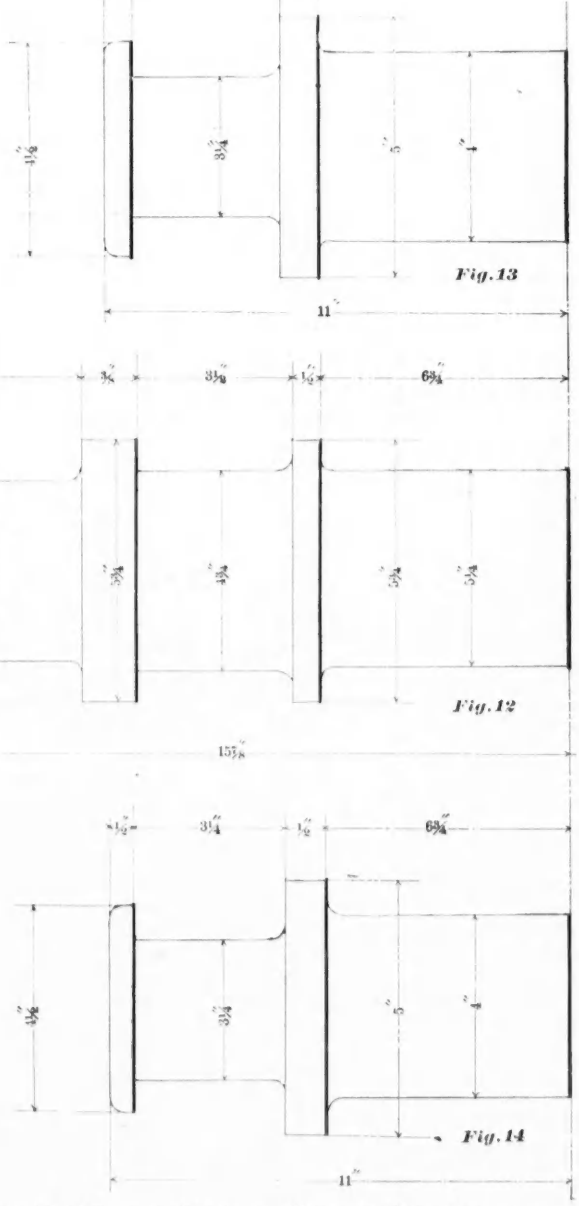
I am in favor of steeel piston-rods and valve-stems for this reason: When I used iron we were troubled a good deal from the rods bending in the yoke of the valve and in the neck of the piston-rod close to the spider. Since the use of steel we have had no such trouble.

In the matter of rocker arms I use a cast-steel rocker, and it is giving good satisfaction. I formerly used iron, but they would break quite often, especially where the link was hung to the rocker. Since I have used cast-steel rocker arms I have had no trouble whatever. I am in favor of wrought-iron slides case-hardened, with a cast-iron crosshead. I have found that we get better results in the wear of the crosshead without brass liners or gibs on than we did when we used brass gibs; besides, it is cheaper and adds strength to the crosshead.

W. H. Warburton,
Master Mechanic.



Steel Crank-Pins for Consolidation Engines.—Cylinders, Twenty Inches Diameter.
Bell's Gap Railroad



Steel Crank-Pins for Ten-Wheeled Engines.—Eighteen-Inch Cylinders.
West Maryland Railroad.

Fonda, Johnstown and Gloversville Railroad.

I am in favor of a good quality of iron for crank-pins. A little experience demonstrates to me the superiority of iron to steel for that purpose. Some seven years ago I had occasion to replace a set of worn-out steel crank-pins with new ones. I had on hand three steel forgings and one low-moor iron forging. I had them fitted as nearly alike as possible and pressed to their places. I had new brasses fitted to each pin all alike, and I find after seven years' trial that a set of brasses will wear nearly or quite double the length of time on the iron pin that they will on the steel ones, and whilst the steel pins show considerable wear the iron one is but slightly worn. The iron pin takes both the main and side rods. I did not try this as an experiment but rather as a matter of compulsion, as those were all the forgings I had at the time. We are using iron piston-rods and valve stems, and I prefer them. However, there are various opinions in this matter, but I speak from my own experience.

I purchase the American Machinist from our newsdealers here. I have had most of the numbers since the paper has been published.

G. V. Putman,
Master Mechanic.

Little Rock and Fort Smith and Little Rock, Mississippi River and Texas Railways.

You may put me down as one who is not discarding steel and again adopting iron. Steel has given us excellent results; iron the contrary. My experience is, that steel has been constantly getting better in quality, and iron poorer.

It is almost impossible to get a good piece of iron to fill the bill where strength and durability are desired, or iron that can be relied on to perform such work as is required of piston-rods, crank-pins, side and main rods, etc.

The iron referred to above, in contrast with steel, is the best money could buy.

F. Hufsmith,
Master Mechanic.

Central Iowa Railroad.

I have no reason to discard steel to readopt iron for use in crank-pins, and will state a few facts in reference to the matter. First, that during the last two years using steel pins in fifty engines there has been only one broken. Second, they wear to a nice polish and run cool. Third, they are more rigid than iron, and seldom get bent except in case of wreck. We have not had a pin sprung out of true for a very long time—so long since I can't remember it. Have had them wear on the journals, and when too bad to run taken them out and trued them in the lathe, and put them back. Years ago we did have trouble with steel pins breaking, but I found it was in the form of the pin, and not on account of the material. That was in the days of square shoulders. Now we have round corners or shoulders wherever strength is required, and necessarily less breakage, not only on crank-pins, but all parts of machinery wherever there is great strain on shoulders or collars.

Steel axles with us did not work well. We tried only a few, twelve engine trucks and two driving axles. Both driving axles broke and two of the engine trucks. Have discarded steel for axles. By slides I presume you mean crossheads. For cross-

heads, steel faced with brass gibs for wearing on slide-bars gives good satisfaction. Have never had one fail in any particular, though we have been using them for the past seven years. Steel for slide-bars is good. It wears to a fine polish, either with brass gibs or cast-iron, well babbited, running on them. We are using for all new crossheads cast-iron, with an $1\frac{1}{4}''$ wrought-iron rod through both wings. They are cheaper to make and strong enough for all purposes that we require. For piston-rods, steel is the best material that we can find. Using metallic packing on them the wear is very small, and a broken steel piston-rod, except in case of wreck, is something that we have yet to encounter. With iron rods it was very different, for we had many break, and mostly at the key-way in crosshead.

My experience with steel is that there are various qualities furnished for the same purpose, and it requires some care to get the proper kind for the purpose needed, and in ordering from the maker it is best always to specify the kind of work the steel ordered is expected to do. This may in some measure account for the results we have had.

Any information you may wish that I can furnish I shall be pleased to write you.

JOHN PLAYER,
Master Mechanic.

MINERAL RANGE RAILROAD.

In reply to your inquiry in regard to the discarding of steel and re-adoption of wrought-iron, my views, though somewhat limited, favor the use of steel. We have steel crank-pins on four of our locomotives —Baldwin's six-wheel connected—and in the past 13 years we have not had a broken crank-pin. This is a remarkable showing considering the inclemency of the weather in Northern Michigan, where for days during the winter it is 30 degrees to 37 degrees below zero. Some time ago, on account of wear and springing, we took out all wrought-iron piston-rods, and now use steel rods with entire satisfaction. One accident happened, however, which perhaps is worthy of note. The piston-rod broke in key or cutter way, owing, I think, to key-way having a square hole, which lessened the strength of material. We now have all key-ways in rods rounding at ends, or, practically speaking, as it leaves the drill, and have had no further trouble. I think you will agree with me that a great many accidents may be traced to inferior quality of steel used by not a few companies who look only at first cost, and think there is no hereafter.

J. SHIELDS,
Master Mechanic.

SHELBY IRON COMPANY'S RAILROAD.

As to my views on the subject of the re-adoption of wrought-iron in place of steel for locomotive crank-pins, axles and piston-rods and guides, I must say that in my judgment (and I have had quite an experience) I much prefer good iron to steel for above mentioned parts of locomotives. I would go farther and take good charcoal hammered flange iron for boilers, in preference to the most of steel boilers that have come under my observation. It is true, if you want a good quality of either, it costs something to obtain it. I have long thought the trade would revert back to those who manufactured a good quality of wrought-iron for above uses. There are many reasons that I could assign for my preferences for iron, but think it useless, as I suppose you merely want an expression of an opinion.

J. S. CHESTER,
Master Mechanic.

NEW YORK, TEXAS AND MEXICAN RAILROAD.

As regards steel crank-pins, I would say that steel don't give as good satisfaction as iron on our road. I have taken out two sets of steel crank-pins and put in iron. They gave us some trouble about cutting, but no trouble since we put in iron pins. We use the iron slides case-hardened. We use iron valve stems case-hardened. They give good results. The steel gave us a great trouble cutting. Steel piston-rods don't give as good satisfaction as iron. They spring and get out of true quicker than iron. As for my experience, I would prefer iron. Steel don't appear to wear well; it cuts and springs. As for steel rocker-arms, we have none in our division.

JAMES MOONEY,
Master Mechanic.

CENTRAL RAILROAD AND BANKING COMPANY OF GEORGIA.

My experience with steel axles and crank-pins has been very limited; but what we have had has not been satisfactory in its character.

D. D. ARDEN,
Master Mechanic.

ST. JOSEPH AND GRAND ISLAND RAILROAD.

Most of the engines on this road when built were provided with steel crank-pins, iron axles, slides and piston-rods. So far we have had only one broken driving axle, and that had been in service for fifteen years, and when broke showed a large flaw in center of axle. This axle before breaking made nearly 400,000 miles, which is a very good showing; yet I believe a good steel axle would have run much longer before giving out, as this axle, when broken, was still quite large. A great number of the original steel crank-pins broke after a few years' service. They were replaced with "Otis steel," as were all that have since worn out; so I may say that all the crank-pins now in use on this road are made from Otis steel, which are giving the best results. The trouble with the original crank-pins was a too high grade of steel, which caused them to break. I have also substituted steel for slides and piston-rods. Have used nothing else for the past ten years. Upon the whole, my practice and observation have demonstrated to my satisfaction the superiority of a good low grade of steel for locomotive crank-pins, axles, slides and piston-rods.

E. SLEPPY,
Master Mechanic.

ASHLAND COAL AND IRON RAILWAY.

We use steel for driving and truck axles also crank-pins, slides and piston-rods extensively with good results. We much prefer iron (case-hardened) pins and slides. They give better results as to wear, and are less liable to abrasion, under all conditions. Roads only having such shop facilities and appliances as are absolutely necessary to keep up ordinary repairs, find steel the most available and economical for many purposes on locomotives, and the question of superiority is not as seriously considered as by roads having approved machinery for making forgings of complicated shapes at a minimum of cost. So steel castings are to former roads a source of convenience as well as economy for rockers, crossheads, etc., where to obtain the necessary factor of safety, cumbersome cast-iron would be necessary, and forgings expensive. Our experience with steel has been very satisfactory throughout, having had but one engine giving trouble with heating journals. That was remedied by using a harder bearing metal. We make it a rule to take out our main crank-pins each time an engine comes to shop for tire turning and general repairs.

I favor steel for boilers and fire-boxes where care is taken in obtaining good grades not too high in tensile strength.

We have excellent water, no scales or injurious deposits of any kind, no patched fire-boxes, though engines with steel fire-boxes have been in constant use for 10 to 14 years. Flues last us from 6 to 10 years. We attribute the good service of the latter to our coal as well as water, for the coal instead of making a sharp, hard cinder (which is very destructive to anything that the velocity of forced draught draws it against) gives a soft, mellow spark that wears flues and stacks but slowly, and the excess of bitumen coats flues, etc., with deposit of soot that protects them from wear. We have one engine in use since 1855 that has the second set of flues, and they without a plug or leak, the engine perhaps having run 650,000 miles.

I look forward to a more extended use of steel for locomotive construction in the future. Much advance has been made in the manufacture of all classes of steel, with the discoveries that compression of fluid steel removes the objection of porosity and defective castings as formerly, and we instead will obtain steel nearly as strong, ductile and dense as forged steel.

E. M. ROBERTS,
Master Mechanic.

DUNKIRK, ALLEGHENY VALLEY AND PITTSBURGH RAILROAD.

In regard to your inquiries as to the merits of steel over iron, for axles, guides, crank-pins, etc., I can simply give my experience as to their relative merits.

I have done away entirely with iron crank-pins, and substituted steel, and the latter has given the most perfect satisfaction. We are using steel axles in place of iron, as fast as the necessities of repairs require new axles, and the steel, thus far, has given much better results than the iron. I am using nothing but steel for piston-rods and valve-stems, and with the most satisfactory results. Our experience with steel and iron guide-bars is in favor of case-hardened iron guides, as they wear much better on brass gibs—the kind we use. As my "opinion" goes with my "experience," I can say but little more on the subject that would be of interest or value.

J. C. HAGGETT,
Master Mechanic.

HOBART AND MANISTEE RIVER RAILROAD.

We have been using steel crank-pins on one of our engines for four years. The engines all came with iron pins, piston-rods and driving axles, and condensed steel slides. We had a good deal of trouble with the crank-pins, and one of them broke short off about $\frac{3}{8}$ of an inch within the wheel, showing a flaw which looked like a butt weld that had only been stuck on the outside from $\frac{1}{16}''$ to $\frac{3}{16}''$ thick. I took all the pins out of that engine and replaced them with steel, and have found that they worked well. Since then I have been working out the iron pins and putting in steel, and I find this advantage: A sprinkling of sand over an iron pin will set it to heating and fill it with scratches. The brass will mix with the iron, and the pin and bearing will look as if the rats had gnawed it. The steel pin will get hot, but scratches but little if any, and the metal does not adhere to the brass. As to the comparative strength of iron and steel I should never make a bearing any smaller of steel than I would of iron. We use medium yellow brass with a double line of babbitt in each section for our pins, and the same grade of brass without babbitt on our steel slides. We use hard yellow brass in our driving boxes on iron axles and have no trouble.

I think when iron can be protected from dust and when the bearing surface is large that it will wear as smooth as steel. I prefer steel for crank-pins, for the reasons I have named, and because it is not flawy.

Some of our engines have steel piston-rods, and the engineers say that it is not half the trouble to keep them packed that it was with the iron ones. We make our steel piston-rods a little larger than the iron ones were when they were new, and make no square corners where they enter the piston-head or crosshead.

It seems to me, if when we use steel we would not try to reduce the size on account of the greater strength of steel we should be fully satisfied with its performance.

W. H. HERBERT,
Master Mechanic.

BOSTON, REVERE BEACH AND LYNN RAILROAD.

I will be pleased to give you, in my rambling way, a little of my railroad experience with iron and steel for the purposes named in your letter.

In commencing let me say that all but one of our locomotives are the Mason bogie type, and that we get all of our important supplies from them. As our locomotives are built to date, or as far as we know now, we shall continue to have them made the same as for three years past.

Our driving axles are made of Mason's best hammered scrap iron (Mason people pile the scrap themselves). The piston-rods are made of steel, crank-pins all of steel, valve-stems of steel, crossheads cast-iron, crosshead guides cast-iron.

We have such satisfactory results from the foregoing that we are not tempted in the slightest degree to deviate from our present practice.

In order to give you some idea of the excessive conditions our locomotives are subjected to, I will say that during the fall and winter months the maximum length of our trains are five cars, with sixty passengers per car. During the months of June, July, August and September the maximum length of our trains are fourteen cars, with one hundred and twenty passengers per car. I don't wish to be understood as saying the above occurs every day during the summer months, but it occurs very frequently. It is a very common occurrence to have twelve and fourteen hundred passengers on one train.

Through all my experience with Mason's locomotives we have not had a broken axle, piston-rod or crank-pin, crosshead or crosshead guide.

R. D. SUTHERLAND,
Master Mechanic.

SHARPSVILLE RAILROAD.

Steel will heat quicker than iron, and when an engine gets to pounding, the steel pins will break quicker than iron. Iron will hold oil longer, while steel is so fine and smooth that it cannot hold the oil. Then, too, it will heat. I never saw iron crank-pins break yet, and I have run a locomotive for 35 years. I am adopting iron altogether since I came here.

Steel piston-rods will burn out packing faster than iron. Brasses will run longer on iron than on steel, because the oil stays between, on account of the two being soft.

JAMES GLASS,
In charge Locomotive Power.

LOUISVILLE, NEW ORLEANS & TEXAS RAILWAY.

I have had some experience with steel for crank-pins and slides, which I think superior to iron. As to steel axles I have had but little experience in using them. For piston-rods I am decidedly in favor of iron, and think it far superior to steel.

E. D. ANDERSON,
Master Mechanic.

KANSAS CITY, ST. JOSEPH AND COUNCIL BLUFFS RAILROAD.

We have been using wrought-iron for locomotive crank-pins and axles. We use steel for piston-rods and crosshead guides. As compared with steel, we have less breakage and better satisfaction with iron crank-pins. Have not used any steel axles. A case-hardened wrought-iron guide bar is one of the best when perfectly true. Still, all things considered, we prefer steel; also prefer mild steel for piston-rods.

F. A. CHASE,
Master Mechanic.

RICHMOND AND DANVILLE RAILROAD (WESTERN NORTH CAROLINA DIVISION).

My experience is that for crank-pins, piston-rods and axles, good wrought-iron is far superior to steel, and for slides I consider cast-iron better than either steel or wrought-iron.

G. W. GATES,
Master Mechanic.

In Glasgow, Scotland, gas has cost users 75 cents per 1,000 feet for years, but it has been determined to furnish nearer at cost, hence a reduction to 50 cents is to be made. It is needless to add that the city furnishes the gas.

It is reported that St. Louis is experiencing a boom in manufacturing, especially in everything having to do with railway supplies.

Practical Drawing.

By J. G. A. Meyer.

NINETEENTH PAPER.

183. In order to point out another instance which will show how advantageously the principles of geometry can be applied to every-day practice, we will call attention to the following problem:

The shortest side of a set square like that shown in Fig. 138 is to be 6½ inches long; the set square to have angles of 90, 60, and 30 degrees; it is required to make a drawing of the set square.

To lay off these angles with a protractor, such as shown in Fig. 127, would be very troublesome, inconvenient, and also require too much time. But now remembering the principles set forth in Art. 38, and also those in Art. 182, we can make a drawing of the set square without laying off or measuring any one of the angles which the set square is to have, thus:

Fig. 138 or Fig. 48, draw the straight line $a\ b$, and make it 6½ inches long; through the point a draw a line $a\ c$ perpendicular to $a\ b$. From the point b as a center, and with a radius equal to twice that of the side, $a\ b$, namely, 13 inches, describe an arc cutting the line $a\ c$ in the point c; join the points b and c by a straight line. The lines $a\ b$, $a\ c$, and $c\ b$, represent the outer edges of the set square. Draw the inner lines parallel to the outer edges, and the drawing of the set square—or at least one view of the same—will be complete, having angles of 90, 60, and 30 degrees.

Problem 27.

184. TO INSCRIBE IN A GIVEN CIRCLE AN EQUILATERAL TRIANGLE.

Fig. 139. The diameter of the given circle $A\ B\ D$ is 15 inches; it is required to inscribe in this circle an equilateral triangle.

Through the center C of the given circle draw any diameter as $A\ E$; from the point E as a center and with a radius equal to $E\ C$—which is the radius of the given circle, namely, 7½ inches—describe the arc $B\ C\ D$, cutting the circumference $A\ B\ D$ at the point B and D. Join the points A and B, B and D, A and D by straight lines. These lines will be the sides of an equilateral triangle inscribed in the given circle.

Directions.—In the space marked Prob. 27 draw a circle 15 inches in diameter by a 3-inch scale. In this circle inscribe an equilateral triangle according to the method given in this article.

Draftsman's Method.—The same as the foregoing.

Problem 28.

185 TO INSCRIBE A CIRCLE IN A GIVEN EQUILATERAL TRIANGLE.

Fig. 140. Let $A\ B\ D$ be the given equilateral triangle; it is required to inscribe a circle in this triangle.

Our first step will be to find the center of the required circle.

By examining Fig. 139 and remembering that the center of the regular polygon is the common center of the circumscribed and inscribed circle, as stated in Art. 178, an easy method for finding the center C will suggest itself.

Notice in Fig. 139 that the radius $C\ E$ is bisected at F by the side $B\ D$, consequently $C\ F$ is equal to one-half of $A\ C$, or to one-third of the line $A\ F$. Therefore, to find the center C in Fig. 140, we proceed in the following manner:

Fig. 140. Bisect the angle A by the line $A\ E$ (Art. 112). Divide the line $A\ E$ into three equal parts; then the first point of division nearest to the base $B\ D$ will be the required center C. From the center C, and with a radius $C\ E$, inscribe the circle; this circle will be tangent to the three sides of the triangle, and will be the inscribed circle.

Directions.—In the space marked Prob. 28 draw an equilateral triangle whose sides are 16 inches long by a 3-inch scale. In this triangle inscribe a circle as explained in this article.

Draftsman's Method.—In small triangles some draftsmen will find the center C by trial; but we believe that by adopting the foregoing method in nearly all cases time will be saved.

But this method is applicable only to equilateral triangles, and cannot be used for finding the center of an inscribed circle in a triangle such as shown in Fig. 141, hence the following problem:

Problem 29.

186 TO INSCRIBE A CIRCLE IN ANY GIVEN TRIANGLE.

Fig. 141. Let $A\ B\ D$ be the given triangle; it is required to inscribe a circle in this triangle.

Bisect the angle A by the line $A\ C$; also bisect the angle B by the line $B\ C$, and cutting the line $A\ C$ at the point C; this point C will be the center of the inscribed circle. Lines drawn through the center C perpendicular to the sides of the triangle will be equal in length, and will be radii of the inscribed circle. Therefore, through the center C draw $C\ E$ perpendicular to $A\ D$. From the center C and with $C\ E$ as a radius, inscribe the circle. This circle will be tangent to the three sides of the triangle, and will be the required circle.

In the same manner the circle in Fig. 140 could have been inscribed.

Directions.—In the space marked Prob. 29 draw to a 3-inch scale a triangle whose sides are 8½ inches, 7 inches and 6 inches long.

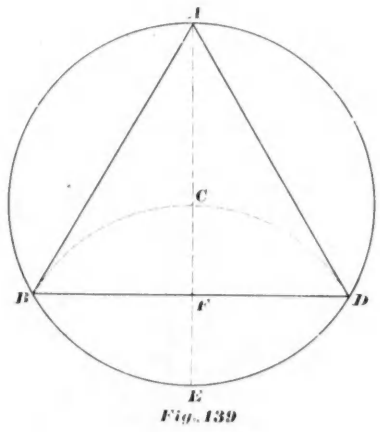


Fig. 139

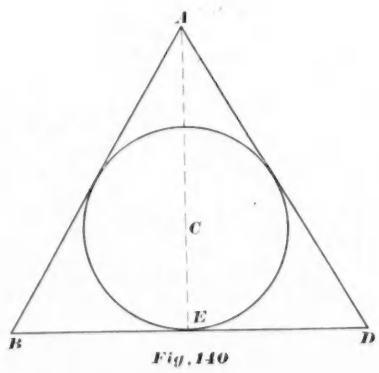


Fig. 140

In drawing this triangle follow the instructions given in Art. 119. In this triangle inscribe a circle. In finding the center C, the student should be very accurate in bisecting the angles A and B, otherwise the circle will not be tangent to the three sides of the triangle; if the student makes a failure of it at first, he should try and try again until he can construct this problem accurately.

Problem 30.

187. TO CIRCUMSCRIBE A CIRCLE ABOUT A GIVEN TRIANGLE.

Fig. 142. Let $A\ B\ D$ be the given triangle; it is required to circumscribe a circle about this triangle.

Bisect any two of its sides, as $A\ B$ and $B\ D$, by the perpendiculars $E\ C$ and $F\ C$; the point C, at which these perpendiculars cut each other, will be the center of the circumscribed circle. From the center C and with a radius equal to the distance between the center C and any one of the points A, B or D describe the required circle. The method of finding the center C is precisely the same as that given in Art. 125.

Directions.—In the space marked Prob. 30 draw, to a 3-inch scale, a triangle whose sides are the same length as those of the triangle in Prob. 29. About this triangle circumscribe a circle as explained in this article.

Draftsman's Method.—Draftsmen cannot employ a better method than the geometrical construction here given.

188. When a circle is inscribed in a given triangle which is not equilateral, and another circle circumscribed about the same triangle, these circles are described from two distinct centers, I and C, as shown in Fig. 142.

189. When a circle is inscribed in an equilateral triangle, and another circle circumscribed about the same triangle, both circles are described from one and the same center, as shown in Fig. 143. See Art. 178.

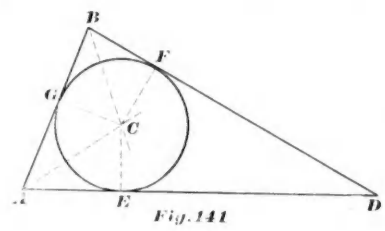


Fig. 141

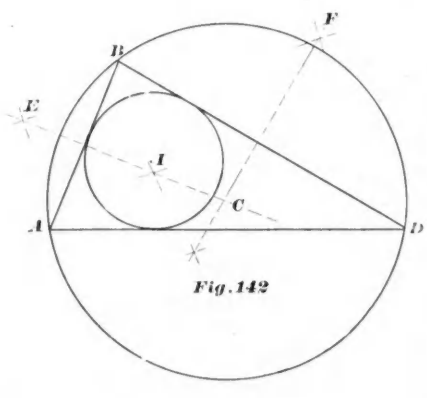


Fig. 142

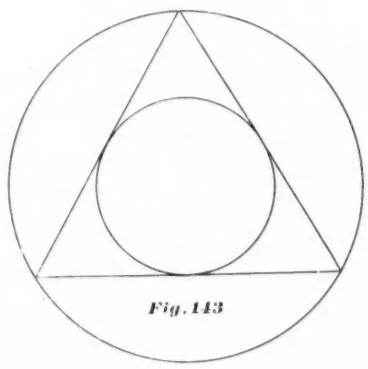


Fig. 143

Subjects for Master Mechanics to Discuss.

The standing committee on subjects for discussion by the Railway Master Mechanic's Association has received a list of suggested subjects for members from J. Davis Barnett, a past president of the Association. They are published in the annual report of proceedings, and as they are very suggestive we copy the list:

SUGGESTED SUBJECTS.

Wheels.—Proportioning and least weight of cast spoked wheels. Is cast-steel not better than cast-iron? (Lighter, and thus reduce weight not sustained by springs.)

Tires.—Fastening, shrinking, proportions, methods of warming, or securing by hydraulic pressure only.

Axles.—Limit for axle mileage in iron and steel. Form and size of journals and collars, etc.

Wheel Seats.—Their proportions. If safe to dispense with keying driving-wheels on axles.

Traction.—Increasers; various types of and their usefulness.

Springs.—Equalizing levers, and spring gear, also value of india-rubber cushioning.

Slide Bars.—Their material, proportioning of surface, grouping, and the relative merits of single, double and quadruple bars.

Crossheads.—Material, relative advantages of loose and solid pins, proportion and shape of cotters.

Slide Valves.—Setting, and shop equipment for same.

False Valve-Seats.—Best metal, and mode of securing.

Link-Motion Design.—From what point should center of radius of link be taken Where center of suspension located, and why? Advantages of wide or close centers on links for eccentric rod connection, or (in other words) the relative advantages of long and short throw eccentrics.

Eccentrics.—Split or solid? Brass or iron? Size (if increased diameter means increased friction) wearing surfaces; curved or flat, recessed or in relief? Butt or flat connections for rods?

Frame.—Forging, relative merits of bar, slab, and compound frames, frame joints, if admissible, and best form of joint.

Securing.—Cylinder and saddles to frame; modes of.

Steam Reversing Gears.—Their types, usefulness, etc., in comparison with screw and lever reversing.

Regulator.—Equilibrium valves, handles, and best form of stuffing-box.

Exhaust Injectors.—Is their use admissible? Description of their different types and peculiarities.

Pony.—Versus the four-wheel truck.

Cab.—Of wood, sheet-iron, or cast metal? Cab curtains and mode of suspending them.

Coiled Springs.—For safety valves; best proportions, material and manufacture, tempering, loss of temper and re-tempering.

Gauges.—Pressure, water, speed and vacuum, a comparison of various makes, value and merits of different types.

Signal Lamps.—For locomotive use (including head-lights.)

Bell-ringers.—Automatic.

Baffle-plate.—Material, and mode of securing in fire-hole.

Arches.—Fire-brick, and other; various constructions, modes of support, and general value of.

Sand Boxes.—And their gear, modern modes of applying sand to rail, delivery of dry sand to boxes, and conveniences for sand-drying.

Sheetings.—Boiler and cylinder coverings, sheetings and clothing.

Balancing.—The reciprocating parts of locomotives, methods and various rules used for.

Tender.—Iron frames for, and iron truck frames.

Lubrication.—Devices for oiling from foot-plate, continuous lubrication, and centrifugal oiling.

Smithing.—Close to size, if economical so to do when work is to be machine-finished?

Case-hardening.—Necessity for, best mediums to use, styles of furnaces, with their relative efficiency and cost.

Office Dials.—Or graphic records, showing condition of repairs, mileage, and condition of all engines and cars.

Returns.—Uniform system for mileage, expenses, prime cost, and departmental charges.

Turn-tables.—Design, material, and anti-friction devices.

Weighing Machines.—For each engine wheel, their various constructions and utility.

Fixed Signals.—From foot-plate point of view.

Lighting-up.—Rapidly, with blast, steam or hot water admitted into cold boiler; describe plant, also plant for washing out with hot water.

Coaling-up.—Various modes of, their cost and efficiency, details and drawings of shoots, cranes, trollies, etc.

Construction.—Advisability, or otherwise, of a railway designing and building all its own rolling stock and power.

Hydraulic.—Power for flanging, bending, riveting and stamping, also for shop and yard capstans, cranes, jacks and boiler testing.

Multiple Drills.—Their usefulness. Types and difference in design and motion gear.

Special Tools.—New or old, invented solely to meet necessities of locomotive construction.

Small Shops.—Versus concentration in large works. Discuss relative merits of.

Annular.—Or longitudinal plan of stalling in engine house. Discuss the relative merits of each.

Moulding.—Shops, moulding machines, and foundry economy generally.

Shop.—Lighting, warming, draining and ventilation.

Wheel Pits.—Various devices for removing truck wheels without lifting locomotives.

Water.—Picking up water on the run.

Water.—Station (an ideal or model equipment), with standard boilers, pumps, pipes, valves, hydrants, etc.

Snow.—And ice, clearing equipment as fitted to locomotives.

Wrecks.—Gear and tackle and staff for promptly clearing.

Moulding Pulleys.

By Robert E. Masters.

Figs. 1, 2 and 3 show the moulding of a web pulley 40″ diameter, 8″ face, rim to be 1½″ thick, from a ring pattern ½″ thick and 6″ deep.

To form the web and give the right thickness of rim, two dry sand cores are struck up inside of the ring pattern. This can be done on a plate or a carriage. The core print and hub are centered, the core sand filled in and struck off to the required depth with the strike *A*. In this case the web was to be the same thickness of rim, 1½″. The strip *B* is whatever width is necessary to make up the desired thickness of rim, and only cuts into the core about 1″ when striking it up as in Fig. 1. This is simply to give an outline of how much to cut off the core with a trowel when the ring pattern is lifted off. After the sand has been shaved off below the groove made by the strip *B*, the strip is unscrewed from the side of the strike and screwed fast on the upper edge, the strike is laid flat side down on the core, as in Fig. 2, the side struck off smooth and dressed up and dried. After the hub has been drawn from the core that is to be used above the web, holes are cut while the core is green for the gate and riser. *C C* are rods bedded in the cores to lift them by and lower them into the moulds. A better plan for lifting the cores, and one that will help secure and bind the core, is to cast a light ring with wrought-iron staples in it (in open sand); but this plan makes it necessary to wait one heat for the rings before the cores can be made, and it is not always that that time is granted.

All foundrymen are familiar with "the old, old story," "we must have this to-day," and if everything that is wanted could possibly be "made to-day," about all the foundries would be shut down to-morrow. Impossibilities are ofttimes expected from the foundry, but, unfortunately, moulders are only common mortals, the same as machinists, pattern-makers and other mechanics, and are only capable of doing ten hours' work in ten hours. But I have wandered away from my subject.

In moulding the pulley the ring is leveled up in the floor or in a flask. The lower half of the core is put in and centered from the inside of the ring. Four cores *D D*, 2½″ diameter, are set on the lower core to support the top core, which is then set in over the center core. The rim of the pulley is rammed up on the outside and drawn up the 2″ necessary to make the 8″ face, strips of pasteboard are laid on to cover the space between the ring pattern and the core, the gates are set in, the cope rammed up and the mould finished. If necessary small blocks of wood can be dropped down between the core and the ring, and pushed back under the ring when it is drawn up at *E E* to support it while the cope is being rammed up.

Fig. 4 is the moulding of a web pulley, 38″ diameter 13″ face. In this case the rim of the pulley was to be as thick as the ring pattern; only one dry sand core was made, as described above, with the strip *B* left off, the bottom half being of green sand. When the first half of the rim was rammed up pieces of plate *F F* were bedded in for the small cores to rest on, so they would not give down from the weight of the upper core. The upper core is then put on and the rim drawn up a little at a time, as shown by the dotted lines, and rammed up on the outside and over the top of the core on a level with the cheek, and the balance of the mould finished up.

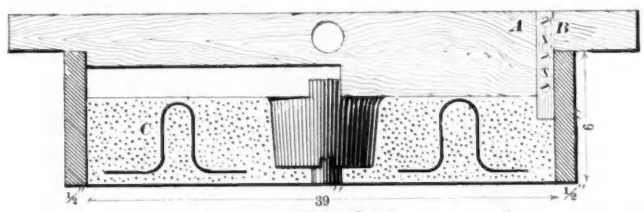


Fig. 1

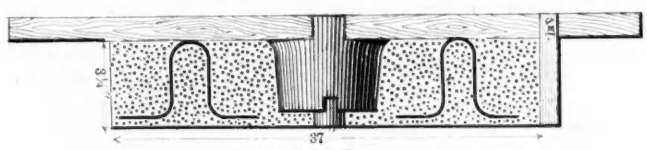


Fig. 2

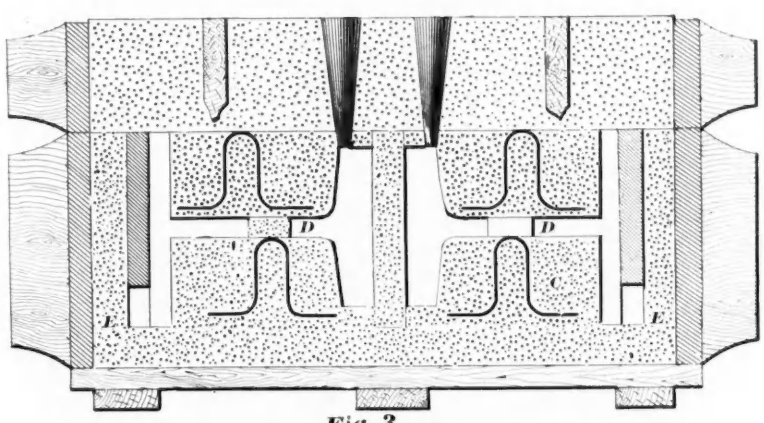


Fig. 3

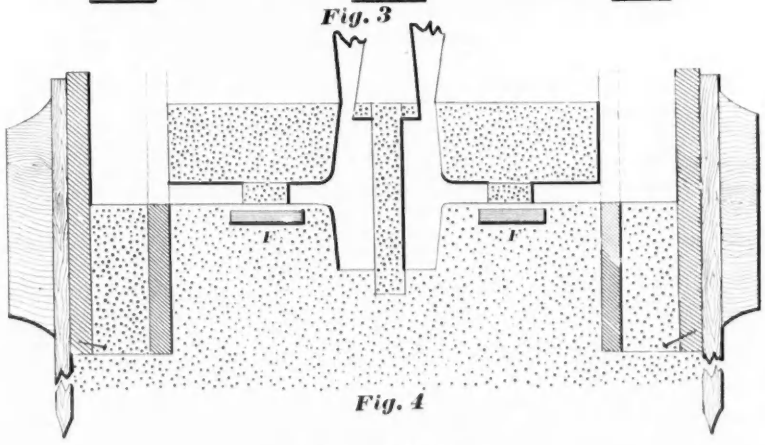


Fig. 4

Moulding Pulleys.

Revision of Steamboat Inspection Rules and Regulations.

At the late annual meeting of the Board of Supervising Inspectors of Steam Vessels some changes were made in the rules and regulations governing inspection. One of them is in regard to ascertaining the tensile strength of plates. The provision now is that the test pieces from plate $\frac{5}{16}$ inch and under shall have an area of cross-section of $\frac{1}{4}$ of one square inch, that for plates over $\frac{5}{16}$ inch and under $\frac{3}{4}$ inch thick the area shall be equal to three-quarters the thickness of the plate in inches, and that for plate over $\frac{3}{4}$ inch thick the area shall be equal in square inches to one-half the thickness of plate in inches.

In regard to lap-welded flues the following new paragraph has been added to Rule II., Section 9:

Provided, however, That all lap-welded flues, 16 inches diameter, and not less than 7 inches diameter, when used under a steam pressure of 120 lbs. and upward, shall be of the same thickness as prescribed in table, Rule II., Section 8, for riveted flues.

Section 5, Rule V., is amended to read as follows:

No person shall receive an original license as engineer, or assistant engineer, except for special license on small pleasure steamers, who has not served at least three years in the engineer's department of a steam vessel: Provided, That any person who has served for a period of three years as a locomotive or a stationary engineer, or as a regular machinist in a steam-engine works at least three years, may be licensed to serve as engineer on steam vessels after having had not less than one year's experience in the engine department of a steam vessel of twenty tons or upward (which fact must be verified by the certificate in writing of the licensed engineer or master under whom the applicant has served,) and no person shall receive license as above, except for special license, who is not able to determine the weight necessary to be placed on the lever of a safety valve (the diameter of valve, length of lever, and fulcrum being known) to withstand any given pressure of steam in a boiler; or who is not able to figure and determine the strain brought on the braces of a boiler with a given pressure of steam, the position and distance apart of braces being known, and no engineer or assistant engineer now holding a license shall have the grade of the same raised without possessing the above qualifications.

Formerly the educational provision of this section only required that the applicant should be able to read and write.

Regarding wheel chains, the addition is:

Masters and pilots of steamers on lakes and seaboard are required to have their wheel-chains rove so that the wheel and helm shall move in the same direction, so that when the wheel is put to starboard the vessel's head shall go to port, and when the wheel is put to port the vessel's head shall go to the starboard.

Section 14 has been added to Rule IX. It is:

When it is known, or comes to the knowledge of the local inspectors, that any steam vessel is or has been carrying an excess of steam beyond that which is allowed by her certificate of inspection, it is recommended that the local inspectors in whose district said steamer is being navigated, in addition to reporting the fact to the U.S. District Attorney for prosecution under Section 4437, Revised Statutes, shall require the owner or owners of said steamer to place on the boiler of said steamer a lock-up safety-valve that will prevent the carrying of an excess of steam, and shall be under the control of said local inspectors.

On the placing of a lock-up safety-valve upon any boiler, it shall be the duty of the engineer in charge of same to blow, or cause the said valve to blow off steam at least once in each watch of six hours or less, to determine whether the valve is in working order, and it shall be his duty to report to the local inspectors any failure of such valve to operate.

In case no such report is made, and a safety-valve is found that has been tampered with, or out of order, the license of the engineer having such boiler in charge shall be revoked.

It shall be the duty of the local inspectors to send a copy of this rule to every steamer in their district when said copies are furnished by the Department.

We are indebted to Supervising Inspector Starbuck for the above information.

Instruction in School Shops.

The Professor of Practical Mechanics in the Purdue University at Lafayette, Ind., William F. M. Goss, writes us:

Those of us who are engaged in conducting "school shops" are anxious to make practical men familiar with our work, not that a false pride may be gratified, but that they may know what it is they so often attempt to criticise, and may see how close a tie binds our common interests. I have yet to find a mechanic who, after having inspected such a shop, no matter how dissatisfied he may have been with certain details, did not think the work as a whole a great advantage to any young man expecting to work for a living.

I have often wished that you, who represent so many of the artisans of our country, and who mold the opinions of so many working men, could delegate a representative to inspect every technical school and every trade school of which we can boast; not that a spread-eagle article concerning each should, of necessity, appear in the American Machinist, but that you may be more impressed with the extent of the work and the earnestness with which it is being advanced.

We have a high regard for well-conducted "school shops," and for the men who are giving their best efforts to the work of instruction in those institutions. They are becoming more and more necessary because of the deplorable opposition to taking apprentices by proprietors of most iron-working shops. There are plenty of bright active boys who would like to learn to be machinists, blacksmiths or skilled workmen of some kind, but who can find no opening. American industries are obliged to look to trade schools well endowed, to provide that opening, or else depend upon immigration to keep up the supply of artisans.

As to the utility of delegating a representative to inspect every technical school, if it were possible, we should have many doubts. While it would be desirable perhaps to publish notes about the facilities for shop practice and methods of work in each trade school, such matter would not possess the interest and value to the students themselves, to say nothing of the great mechanical public, of equally well prepared notes on the methods of practice in regular machine shops that are run only for commercial purposes. In these shops students expect to work for a living. The more familiar they can become with the methods of work in the best shops the better will be their chances of advancement. They must know what to do and how to do it to accomplish results. The wasting of time and spoiling of material will not help them to economize either, when they go into a shop to earn a living. School shops should be modeled closely after the best shops for commercial work.

The Vermont Board of Railroad Commissioners, taking cognizance of the recent holocaust on the Central Vermont Railroad, strongly recommend the abolishment of stoves and oil lamps. But ex-Governor Smith, who practically controls the road, raises the old Tweed conundrum, "What are you going to do about it." Judging from past experience the Governor will come out ahead.

An alloy named Mock iron is used for filling blow-holes in castings. It is made of one part of bismuth, two parts of antimony and nine parts of lead. It is claimed that this alloy will expand in cooling. A hole filled with melted alloy will not show any acks, and the plug will be tight.

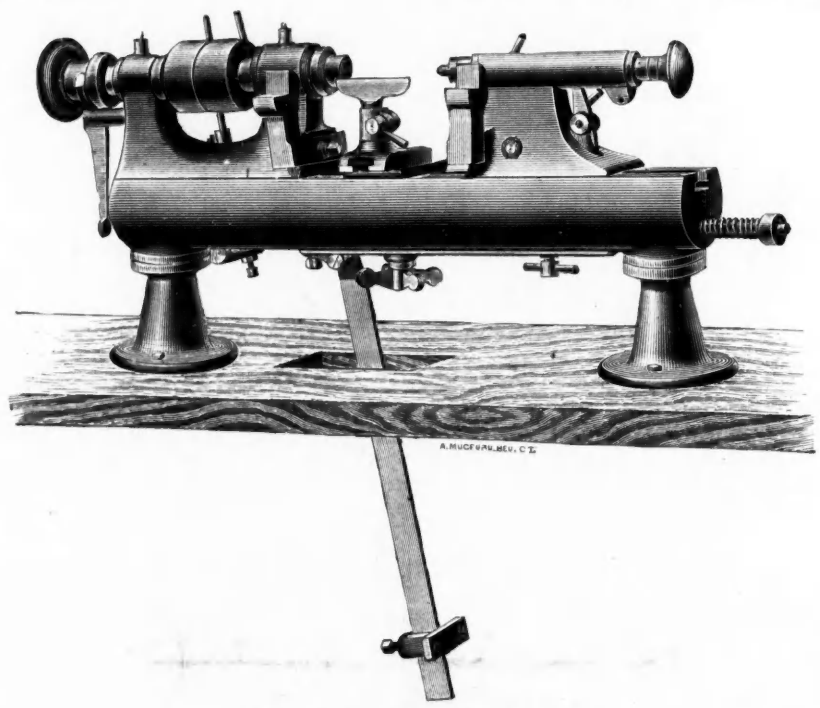
Norton's Semi-Automatic Lathe.

This lathe is especially designed for light manufacturing where large quantities of small duplicate lathe work is required. It is so constructed as not to require the attention of the operator to the movements of the machine.

The operations of starting, stopping, grasping and discharging the work are accomplished by one motion of the knee, leaving the operator entirely free to attend to the other operations in connection with the work proper. This, with the use of combination slide gauge tools, or with cross rest or slide rest, will be found to execute the work of turning, burnishing, spinning or trimming of all kinds of light lathe work, very nearly approaching the rapidity of an automatic machine, and with the accuracy of a first-class lathe. It has special bearings so arranged as to take up the wear in line from strain of work and belt, and they are especially constructed for high speed, admitting of a speed of 6,000 revolutions per minute. It is so arranged as to be immediately changed from one kind of work to another, including the changing of chucks and all other necessary adjustments.

The dimensions of lathe are as follows: Length of bed 24 inches; distance between centers, 8 inches; swing, 7½ inches; hole in spindle, ⅜ inch; diameter of front bearing, 1 inch; length of front bearing, 2⅝ inches; diameter of back bearing, ⅞ inch; length of back bearing 2 1/16 inches.

The manufacturers of this lathe are the Hendey Machine Company, Torrington, Conn.



Norton's Semi-Automatic Lathe

LETTERS FROM PRACTICAL MEN.

Notes and Inquiries Relative to Anthracite Coal.

Editor American Machinist:

Does any one know what is the heating effect developed by the perfect combustion of anthracite coal?

Perhaps many of your readers will consider the question absurd, when so high an authority as Prof. Rankine says that the heating effect, in British thermal units, of one pound of combustible in the coal, is

$$14{,}500 \times \left\{ \text{proportion of carbon} + 4.28 \times \left(\text{proportion of hydrogen} - \frac{\text{proportion of oxygen}}{8} \right) \right\}$$

But since the time that Messrs. Kestner and Meunier made their celebrated experiments, showing that the heat of combustion developed by a large variety of coals was greater in every instance, than the amount given by the above formula, the formula itself has been regarded with distrust by many authorities (see, for example, Percy's Metallurgy, Barr on Combustion, Shock on Steam Boilers, and Watts' Dictionary of Chemistry, third supplement.

In 1864 there appeared a valuable publication entitled, "Report of the Board of Engineers on the Experiments tried with the Horizontal Fire-tube Boiler and the Vertical Water Tube Boiler, designed for the purpose of Comparison." This report was signed by W. E. Everett, Miers Coryell, William Bromley, Chas. W. Copeland, B. H. Bartol, J. Vaughan Merrick, Wm. C. Hibbard, Wm. Wright, B. F. Isherwood, and contained the following "explanatory note."

"The quantities opposite the title 'Percentage of Perfect Absorption of Heat,' have been calculated by comparing the 'pounds of water evaporated from water at 212° per pound of combustible,' with the theoretical evaporation due to the heat developed by one pound of the combustible of anthracite coal, viz: 14.9115 pounds of water. This value was obtained by taking the amount of heat which would be developed by one pound of carbon (as found by experiment), in anthracite (16.5683 lbs.) deducting for the earthy matters, and considering that 90 per cent. of the residue is carbon, the rest being a combination of gases, of which the heat-producing effect may be disregarded."

The "Board of Engineers" did not give their authority for the statement that the heating effect of anthracite-carbon is equivalent to the evaporation of 16.5683 pounds of water from and at 212° per pound of carbon. This value agrees fairly with the results obtained by Messrs. Kestner and Meunier, and if any of your readers can furnish references to or details of the experiment by which the value was determined, the information would probably be of interest to engineers.

In *Van Nostrand's Engineering Magazine*, August, 1884, a writer, who poses as an authority on engineering questions, made the following statement:

"It would be reasonable to suppose that anthracite, in which the carbon is probably as compact as in gas retort charcoal, would have a similar heating value, or about 14,500 heat units."

The appended table throws some doubt upon the reasonable character of the foregoing supposition.

HEATING EFFECT AND SPECIFIC GRAVITY OF CARBON IN VARIOUS CONDITIONS.

Condition of Carbon.	Heating Effect in British Thermal Units per pound of Carbon, from Favre and Silbermann's Experiments.	Specific Gravity. Value.	Specific Gravity. Authority.
Charcoal from Sugar	14471.6	.....	.....
Wood Charcoal	14544.7	1.428–2.002	Clarke's "Rules and Tables."
Gas Retort Charcoal	14485.1	1.885	Clarke's "Constants of Nature."
Graphite of various degrees of purity, No. 1	14060.7	1.802–2.585	Clarke's "Constants of Nature."
Graphite of various degrees of purity, No. 2	14013.5	1.802–2.585	Clarke's "Constants of Nature."
Graphite of various degrees of purity, No. 3	14006.7	1.802–2.585	Clarke's "Constants of Nature."
Graphite of various degrees of purity, No. 4	13926.8	1.802–2.585	Clarke's "Constants of Nature."
Diamond	13986.2	3.492–3.5295	Clarke's "Rules and Tables."
Anthracite Coal, French	.....	1.34–1 46	Clarke's "Rules and Tables."
Anthracite Coal, Irish	.....	1.59	Clarke's "Rules and Tables."
Anthracite Coal, South Wales	.....	1.26-1.36	Dana's "Mineralogy."
Anthracite Coal, Pennsylvania	.....	1.32-1.7	Dana's "Mineralogy."
Anthracite Coal, Rhode Island	.....	1.81	Dana's "Mineralogy."

The reports of experiments on the heating effect of carbon, quoted above, did not contain the specific gravities of the substances tested, and if any determinations of the specific gravity of the carbon in anthracite coal have ever been made, they have escaped the writer's notice. Anthracite coal contains from 3 to 10 per cent. of incumbustible solids, with a specific gravity of about 3; so that the specific gravity of the carbon in the anthracite must be less than the specific gravity of the coal. Wherefore, it does not seem "reasonable to suppose that" the carbon in anthracite coal "is probably as compact as in gas retort charcoal," and an engineer to whom the above statement and table were shown, remarked very aptly, that the writer in *Van Nostrand's Engineering Magazine*, if he was a little astray in his reckoning of the density of anthracite-carbon, succeeded admirably in demonstrating the density of his ignorance about the subject which he was discussing.

The above table illustrates a familiar fact: That the heat developed by the combustion of carbon generally decreases as the density of the carbon increases. A pound of gaseous carbon, as is well known, will develop by its combustion about 20,000 British thermal units; so that the heating effect of carbon in coal may vary, according to the density of the carbon, between 14,000 and 20,000 heat units per pound. The hydrogen contained in coal, on the other hand, being ordinarily more dense than gaseous hydrogen, may be expected to develop a smaller heating effect than would be obtained by the combustion of the gas; so that the formula long used for calculating the heating effect of a coal whose composition was known, might well be relegated to a secondary place, in future treatises on combustion, and experimental determination of the heating effect of various coals be placed in the front rank.

The present notes are published in the hope of inducing other engineers who have investigated the subject of combustion, to contribute the results of their researches and experiments. Probably no one will deny that the subject treated is an important one, and that, if the old methods of calculation are defective, the time is ripe for something better.

Richard H. Buel..

Boring Crank-Pins to Prevent Heating.

Editor American Machinist:

I have noted with interest your inquiries and replies relating to the use of iron and steel in locomotive construction. The evidence of some of the best locomotive engineers, whose testimony you published in your issue of March 5th, would seem to show us that wrought-iron crank-pins and axles are the most economical in locomotive construction and in the necessary repairs. I think the failure of steel crank-pins and axles has been largely due to the selection of the grade of the material, and the form of the pins. I notice that some of the master mechanics state that even pins of mild steel have failed, but I think that if the metal had been uniform in quality they would not have broken with any ordinary service.

The writer has never been able to find a thoroughly uniform grade of steel, but has used some of the best steel forgings obtainable in this country, and after drilling a hole through the center of the pin, equal to about one-third of its diameter, has annealed it slowly, producing a uniform appearance in section. These pins were used on marine engines, and of course were not subjected to the crystallizing effects of the wheel and rail, as in the case of the locomotive. All of the running gear of a locomotive is subjected to constant concussion, and consequent crystallization, therefore, the best charcoal irons will give the best results in the long run.

I do not think the builders of steam hammers make many piston-rods of steel, for we find most of them of the very best grades of wrought-iron; even these piston-rods frequently break if they are not proportioned and attached to the piston and hammer-head with the greatest care, and all show crystallization under these favorable conditions. I should say that one of the best forms for any locomotive pin is that shown in Fig. 7, and used by Mr. Stevens, of the Lake Shore and Michigan Southern road, as the pin has no shoulder next to the wheel, and its projecting neck is reduced in weight as much as possible.

As a rule I do not think that locomotive crank-pins are any too large, as the pressure per square inch upon them is far above anything in marine or stationary practice, and they must be fitted well in order to avoid heating and cutting. I do not think it possible to obtain a perfectly uniform locomotive axle of steel, on account of their size. I should prefer wrought-iron for axles, but should use a steel shaft in a stationary engine.

My idea in boring a hole through the crank-pin was to displace all extra metal that would be liable to hold heat, and also to leave an opening to carry off this heat in case the pin worked warm under high speeds, and I found that this hole gave excellent results in annealing.

W. H. Hoffman.

Heating Cars by Steam from Locomotive.

Editor American Machinist:

In your issue of January 29th I read with much interest an editorial regarding heating railroad cars by steam.

About two years ago I witnessed a test on the Chenango & Allegheny Valley Railroad at Greenville, Mercer Co., Pa., of a method of heating by steam which gave complete satisfaction to all who witnessed it, amongst whom were Mr. A. H. Steele, the President of the Road, I. T. Blair, General Manager, E. Richardson, Master Mechanic, and several officials of the N. Y., P. & O. The system, for simplicity and economy in the consumption of steam, certainly showed, that steam heating on passenger cars can be successfully used with the utmost safety, and it was clearly demonstrated to be cheaper than the antiquated and deadly system of heating with stoves.

On the day of the trial the coaches on the train had been standing on the siding without any fires, to enable the stoves to be removed, and the steam radiators to be fitted up; yet nevertheless, seven minutes after the steam had been turned on at the locomotive through a ½″ pipe, the thermometer registered 65° F. in the rear coach, and in twenty minutes the radiation had to be reduced one-half, as the cars had become uncomfortably warm. The pressure on the pipes indicated 5 lbs. per square inch, the reducing valve being placed on the locomotive.

At the trial, while the train was running 20 miles an hour, the rear coach was purposely detached from the train, to show the extent of the danger, if any, which might be apprehended from an accidental rupture of the steam connections, but the only result was a slight puff of condensed steam, fully showing that no danger need be feared from that source.

It was observed that the pressure on the

steam gauge suddenly dropped between 12 and 15 lbs., upon the steam being turned into the cold radiators, but immediately upon these becoming heated, the rise in pressure began, and the normal pressure was attained in about ten minutes, after which, the engineer and fireman could observe no appreciable increase in the consumption of coal, during the run of 56 miles. The steam connections between the cars seem to answer admirably, the couplings used showing no trace of leakage.

In face of such a cheap, safe, and easily applied mode of car heating as this, it seems puerile, on the part of railroad corporations, to justify their retention of the deadly stove, on the plea that no practical system of steam heating has yet been discovered. I trust you will persevere in your efforts on behalf of the traveling public, to bring about a reform. TRAVELER.

[What our correspondent writes is of value, considering the interest in heating cars from the locomotive, but its value would have been greater if he had given the number of cars heated, and the outside temperature.]

A Shop Kink Without a Shop.

Editor American Machinist:

Among the new things I have been obliged to learn is that all wit, wisdom, mechanical science and shop kinks are not massed in big institutions with fine offices and luxuriant drafting rooms, under the direction of an M. M., or M. E., or S. E., or C. E., or any E. But that there is occasionally a genius in the rough, hid away in some obscure town, whose only mechanical knowledge has been gained from mother wit and tinkering in an old saw mill or a country blacksmith shop. That the saw mill is still there, and also the blacksmith shop, is fully attested by the fact that I was there last week and saw Sam Hornsby do a job in the latter for the former that I am not likely to forget. To make everything clear, it is necessary to give a brief description of the situation, viz: The above mentioned saw mill runs by steam and the water is taken from a well 60 feet deep, and the pump (an ordinary old style plunger pump) is located about 40 feet from the surface on a platform in the well. Power is transmitted to it by means of a long Pitman rod, and the water pumped up into a tank in the engine room, and then pumped into the boiler. (No inspirator or injector in that mill.) Now this pipe that connected the tank with the lower regions pump had got stopped up somehow with something, and had to be taken out. The stopage was finally located, but resisted all attempts to dislodge it. Even the end of a $\frac{1}{2}$" rod, hot or cold, had no apparent effect. As a last resort the blacksmith Sam was called over, and the situation explained. His first move was a look at the boiler with a view to attaching this stubborn customer to the blow-off pipe and trying boiler pressure on it; but there was no pressure in the boiler. So he took the pipe over to his shop, fitted a short wooden plug with considerable taper, to the end of the pipe. This plug he fastened to the inside bottom of an ordinary three-hooped wooden water pail. Then he removed the two lower hoops, and filled the pail with water. His next move was to heat about a foot of that pipe, at the end nearest the stoppage, to almost a welding heat. Then he raised the pipe in a vertical position over the plug in the pail, took deliberate aim, and jammed it down: the end of the plug went into the end of the pipe, and the bottom went out of the pail. Sam held the pipe still in a vertical position and bore down with all his might. In about a quarter of a minute there was a smothered hissing, gurgling, snapping noise, and something went out of the top end of that pipe like a sky-rocket. As Sam Hornsby laid down that pipe his face wore a glow that would have done credit to the countenance of Captain Ericcson when the Monitor was completed. J. A. X.

We note an unusual number of patents for stove-pipe dampers. Dampers don't amount to much. What is wanted is a device that will make every end of every length smaller than any other end of any other length.

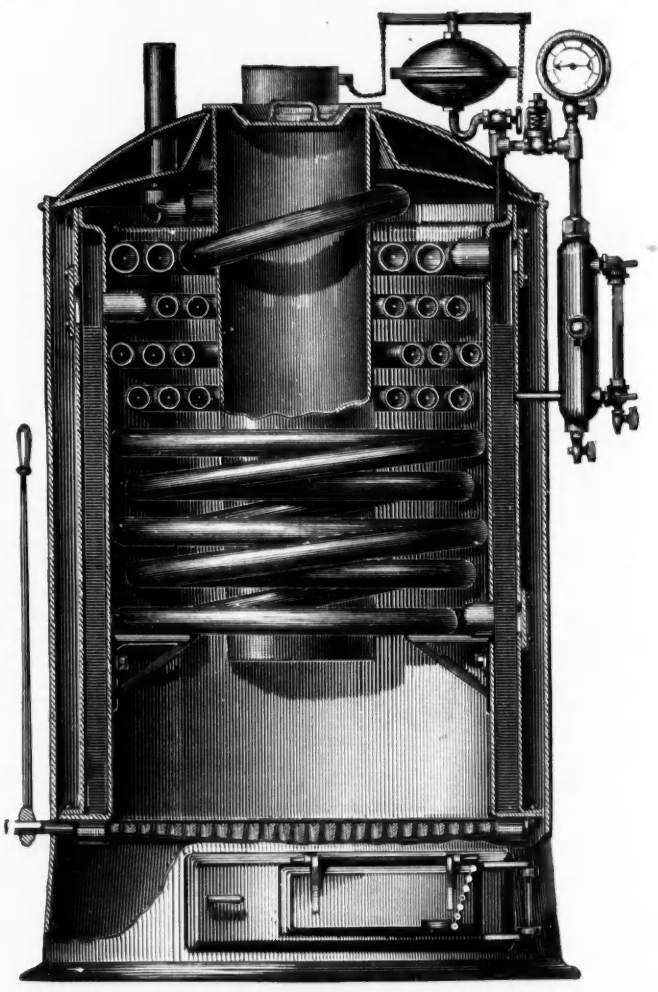
Steel and Coil Boiler.

This boiler, although designed more especially for heating purposes, is by slight modifications adapted for small power stationary engines, and particularly for small steam yachts. It is made entirely of steel and wrought-iron. There are few joints, and these are made of copper.

It is claimed for this boiler that it cannot be cracked or exploded, although water be let into it when dry and the boiler hot.

It is also claimed that after three years' use the coils are found free from sediment of any kind. The manufacturer is Dan. W. Kellogg, Auburn, N. Y.

Some months ago we noted that the Hartman Steel Company, of Beaver Falls, Pa., had established a hot coffee and lunch room for their employes, where for a trifling expense each of them could have a warm meal. The lunch room was to be conducted in part by employes. This company seems to take an interest in their employes as men, not regarding them solely as factors of cost in production. They are now assisting in establishing a co-operative



STEEL AND COIL BOILER.

store or employes. It is proposed to furnish everything usually called for in a family. When the works are running patrons will pay cash, and when idle credit will be given to the amount of stock each patron holds. This is just the opposite of the "company store," or, as the workmen call it, the "pluck me" system. It would be a good move for other manufacturing companies to encourage co-operative stores for their workmen as a bright contrast to the cormorant style of those who absorb their employes' substance through company stores.

A Nugget of Information in the Machinery Line.

Steele & Condit, who conduct a general machinery and foundry works, which are situated on the line of the Pennsylvania railroad, have built, placed and have in operation a machine of which they do not care to say anything at present. The machine has been in operation about six months, and the principle is just the opposite of all former makes. When the machine has demonstrated the correctness of its principle and produced a test record we will illustrate it. This is the concern that built the dredgers and grapplers now at work on the Panama canal.—*American Manufacturer.*

A Satisfactory Test.

A patent attorney, who in the interest of one of his clients wanted his application for a new torpedo boat made "special," undertook to show the Commissioner how simply and easily it would work. At his request a tub of water was brought in, and the attorney prepared to experiment with his specimen bomb. After a learned disquisition on its merits before the Commissioner, and in the presence of quite an array of clerks who had gathered to witness the experiment, he chucked his torpedo boat into the tub of water. The denouement was decidedly more successful than he had anticipated. As it struck the water it exploded with a terrific and fear-inspiring report, lifted the water bodily from the tub, and sent it in solid and forcible streams all over the room. One section struck Commissioner Montgomery squarely in the chest, and then rebounded on the books and papers spread on his desk; another stream effectually stopped up the mouth of the patent attorney, and violent and scattered sprays drenched every one in the room. It was not a moment before the room was vacated, or those who could not get out were under cover. After equanimity was restored, the Commissioner, as he wiped the water from his clothes, remarked that the experiment was entirely satisfactory, and the patent should be issued forthwith.—*Baltimore Sun.*

This time it came about through the explosion of a hot water heater in a car on the Wabash road. But the car was fired all the same. Fortunately the train was at or near a station, and no passengers were burned, though several were injured more or less by the explosion.

At present there are indications that railroad authorities will adopt safer methods of heating cars than now in use. But whether steam is to be used for this purpose or hot water, has not been decided. It is absolutely necessary that a reform in heating the cars should be made at once.

Celebrating the Completion of 100,000 Inspirators.

On the evening before Washington's birthday anniversary, about a hundred business men and professional men gathered at a banquet given at the Quincy House, Boston, by the Hancock Inspirator Company to celebrate the completion of a hundred thousand inspirators. Among those who occupied seats at the tables were President H. M. Whitney, Treasurer J. E. Blakemore, Superintendent Warren, Counsel E. P. Howe, Clerk W. R. Lavender, and others, controlling mechanical operations, including motive power of railroads; also representatives of the *Advertiser*, *Globe*, *Journal of Commerce*, AMERICAN MACHINIST, and one or two other newspapers. The representatives of the press were seated at the right of the President and the Treasurer. Songs by the Temple Quartette, and ventriloquism by Mr. Prescott enlivened the banquet. President Whitney gave a resume of the rise and progress of the company's business. Over ten years ago Samuel A. Randall, now connected with the company, induced him to go and see an instrument perfected by Mr. Hancock, and called an inspirator. It was raising water from a cellar to an upper room. He agreed with the inventor to form a company, which he did promptly. In August, 1876, the manufacture was begun, and the first year 268 instruments were sold, but they cost more than they realized by sale. For some years there was a deficit, but he never lost his confidence in ultimate success. Then came a turn in the tide, and every year since then has shown an advance until, now a hundred thousand inspirators have been made, and it was fitting that some recognition of its remarkable success should take place.

Brief speeches of congratulation were made by several gentlemen present, some of whom spoke from experience in the highest terms as to the value of the inspirator in feeding locomotive and other boilers.

Treasurer Blakemore said it was the policy of the company to make friends rather than enemies. They had made friends even of their competitors. Of the hundred thousand inspirators sent out scarcely 25 had been sent back on account of a defect. They had paid out $50,000 a year for labor alone, and he spoke earnestly of the faithful help of their employes.

Supt. Warren made a happy speech in which he dwelt upon the pleasant relations that had always existed between the company and its employes. The dinner was excellent, and all the guests declared the occasion a very pleasant one and long to be remembered.

A reader in Yale, British Columbia, writes us:

"Out here in British Columbia, on the mainland, wages run from $2.25 to $3.00 per day; blacksmiths and boilermakers the same. On Vancouver Island a man may get 50 cents more a day. Board, $6.00 per week. All other necessary things are higher in price than in the East.

Nearly all who come from the East get disgusted at first, and many would not stay in the country if they had means to get away. Private shops are but few and a steady job is a rare thing. There are always plenty of men about, and they can get them at any time. We have one railroad at present—the Canadian Pacific.

Judge Gresham, after the examination of a number of bills for attorneys' fees, presented to him by the receiver of the Lake Erie & Western Railroad, remarked that the receivership was being made too expensive, and proceeded to cut the bills down one-half. Since attorneys' bills are often extravagant and unreasonable, we believe that this step in connection with "railway regulation" should be taken by every court in the country. The average receiver finds little difficulty in getting away with the bigger part of the receipts of the unfortunate railroad that goes into his hands.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

Horace B. Miller, Pres't.
Jackson Bailey, Vice-Pres't.
Lycurgus B. Moore, Treas. and Sec'y.
96 Fulton Street, New York.

Jackson Bailey, Editor. Horace B. Miller, Business Manager.

F. F. Hemenway, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 Bouverie Street, Fleet Street, London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
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NEW YORK, MARCH 12, 1887.

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This issue of the American Machinist presents itself in a new dress of type. Our readers will observe a freshness in the print, but just the same originality of contents as before. Good mechanical thought, expressed in good intelligible English, upon clean white paper and in clear type, are the points we aim to maintain. We have gained some experience like that of machine shops whose work goes on increasing steadily: the tools wear out sooner. Our dress of type laid aside this week was used but a little more than half as long as the last previous dress, all dresses of type being purchased new.

A Righteous Verdict, But Without Effect.

The coroner's jury in the case of the "accident" on the Baltimore and Ohio railroad, last January, a catastrophe in which several lives were lost under peculiarly horrible circumstances, has done its duty admirably and should receive the full measure of praise. It is generally in such instances a difficult matter to find just where the blame lies, owing to the whitewashing processes resorted to, and the feeling that somehow a great corporation has certain rights to do wrong, that ought to be respected. This jury seems to have been made of honest stuff.

It will be remembered that at the time of the—by courtesy accident—the engineer of the freight train into which the express crashed was accused of having been drunk, and this was held to account for his being in the way of the express. The coroner's jury finds the charge of drunkenness to have been without foundation, but it does find that he "was worn out with sixteen hours and fifteen minutes' continuous duty with a green fireman and a poor engine which had been reported unserviceable." Finally the leaky fire-box put out the fire and brought his train to a stand-still.

The jury also finds that the brakes on the express were inefficient, operating but slightly to decrease the speed of the train, which was little more than forty miles an hour, though applied for a distance of 1,000 feet. It also finds that the heating and lighting appointments of the express train were contrary to law, and such as to make the holocaust after the collision practically certain. The verdict condemns the railroad management with no uncertain phrases; the language is plain enough to be comprehended by even the average legislator.

Stripped of unnecessary verbiage the killing upon that occasion was homicide, pure and simple. It cannot be said to be due to accident. After such a sweeping verdict it might be expected that the guilty parties would be put upon trial for the offense. But nothing of the kind will be done. Wholesale murder, if done by a railroad corporation, is not an offense in Ohio. Very conveniently there is no law for indicting or trying anybody, in such a case, and Ohio is not much better or worse than other States in this respect.

It will look to many as if the cost in time and money to determine just who was responsible for the death of the known and unknown at Republic represented an unwarranted expenditure. But something must be done to satisfy public clamor, and while this verdict will act as a safety-valve on the public, it has the additional merit of being quite harmless so far as its effect on railroad magnates is concerned. They will stand such verdicts with perfect equanimity and at regular and frequent intervals, provided no restraint is placed upon the operation of their roads. If the engineer had been content to rest under the charge of drunkenness it would have been a still easier way to have hushed the matter up, but as it is it will put the guilty parties to no inconvenience.

There may be one other use for this verdict; that is, let copies of it, duly attested, be hung up in the legislative halls of every State. After a time it may impress legislators with the fact that what is wanted is not only a law that metes out the same punishment for homicide on a railroad that would be accorded to the individual or individuals elsewhere, but a law that provides a long term of imprisonment to somebody every time conditions are found similar to those that existed just previous to the Ohio disaster, such as express trains fitted with apologies for brakes, leaky and condemned locomotives pulling trains, engineers morally and physically unfitted for duty by long hours, and cars heated and lighted contrary to law. If a man unloads his revolver into a crowd of people he is reasonably certain of punishment without much reference to whether or not he meditated murder. It has even been found possible to punish those who purposely erect unsafe buildings that fall and kill people. Possibly some means might be worked out whereby railroad officials could not only be punished for murder, but restrained from going about equipped for it. At any rate the contemplation of a copy of the Ohio verdict would be a reminder of the fact that crime was being committed.

We congratulate the jury that has not been deterred from doing its duty and making it clear where the blame lies, but regret, undoubtedly with them, that their good work is to be without immediate effect.

Again this week we publish a collection of interesting and valuable letters from railroad master mechanics, giving their opinions and experience in the use of steel and iron for locomotive crank-pins, slides, axles and piston rods. It is not remarkable that some prefer iron and others steel. The remarkable feature is that many who have used steel for some or all of the parts above mentioned should return to the use of iron. We have no interest for or against either metal, but are essaying to show where and why changes have been made from iron to steel and from steel to iron. We shall be glad to receive information from any road that will throw any light upon this subject. A majority of the men in charge of the mechanical departments of railroads seem to favor iron for crank-pins, at least. Last week and this week we publish cuts of several crank-pins and letters on the subjects above mentioned from about seventy master mechanics. We shall not drop the matter yet.

Begging for the Militia.

We have received a circular appealing for contributions to equip Co. B. 1st Regiment, N. Y. The appeal, which is signed by J. William Lee, Captain Commanding, says:

"We need the sum of $1,600 to equip our company complete. Will you generously aid us by either purchasing tickets for concert or subscribing to the fund?

"If so, please fill the enclosed blank, and return to the undersigned."

If the State of New York wants this company it should furnish it with equipments, and if it don't want it the organization ought not to be recognized or mustered into service. Not one cent from us, Captain. Congress has recently appropriated $400,000 for equipping the militia and every State spends money to maintain its citizen soldiery. But this does not seem to suffice, and a resort is had to begging funds from the public. We regret to see such a movement. It forebodes evil. Troops that are equipped at public expense owe allegiance to the public at large, and are under no obligation whatever to private parties. Troops that are equipped by contributions of private individuals must feel some gratitude to the donors. Jay Gould and other heads of big corporations that employ thousands of workmen are just the parties to be smitten by liberality when such an appeal as we have above quoted is placed in their hands. Let there be a strike of the workmen of some large corporation and let them gather in mass near the company's property to watch proceedings (as most men are likely to do.) This is the occasion when the managers call for armed force, and if in response a militia company is sent that they themselves have helped to equip, the chances are very strong that the arms and accoutrements will be put into active use and innocent people slain.

It is but a step from providing equipments to selecting the men who shall wear them. In the case mentioned the circular of appeal says Co. B is "entirely composed of young men who are pledged to total abstinence" and that "in order to accomplish the purpose for which it was organized, it is necessary to equip the men as soon as possible." Of course the temperance qualification will meet public approval, but we are in doubt as to what particular object this company was organized to accomplish, that it is necessary to hurry up its equipment. Certainly if the emergency is one recognized by the State authorities (under whom the company is to serve) it should at once be equipped at public expense.

In whatever light this begging action is placed, it casts a bad shadow.

In her last voyage to New York the Etruria put the mails ashore on Saturday that had been taken on at Liverpool the previous Saturday. The passage was made at an average speed of nearly 22 miles an hour.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(100) E. M., Astoria, L. I., will find his question in regard to pitch of propellers answered in the American Machinist of June 28, 1884.

(101) W. E., Pictou, N. S., will find sketches and description of blue-print frames in the American Machinist of May 29 and July 31, 1886.

(102) J. B., Birmingham, Conn., will find the information he asks for in regard to screw cutting in the American Machinist of August 13 and 20 and October 15, 1881.

(103) A., asks: How is the incline of small distances usually spoken of—by the foot or yard? *A.*—Both ways. Batter of walls is generally spoken of as by the foot; earth cuttings frequently by the yard. The most common unit is the foot.

(104) What is the highest horse-power that an engine 7"x9"—steam ports, 3⅛ inches by 17-32 inch: travel of valve, 2 inches; lap, 15-32 inch—will develop with 125 lbs. steam pressure; revolutions, 222? *A.*—Probably about 25 indicated horse-power.

(105) E. L., Detroit, Mich., asks: 1 Where can I have a chilled roll made for polishing stained lumber, the roll to have a shaft through center? *A.*—Apply to any iron foundry in Detroit, or inquire at some iron works. 2. How do you think such a roll would work? *A.*—We do not know enough of the requirements to judge.

(106) S. G., Truro, Nova Scotia, writes: We have to cast the lead keel of a yacht, to weigh 5,000 lbs. Can you tell us how to melt the lead without building a furnace? *A.*—It will not require a very large foundry ladle to hold 5,000 lbs. of lead, and you can construct a temporary brick setting, using stove pipe to get draft. If one ladle is not large enough, use two or more.

(107) C. G., Pittsburgh, Pa., asks: Is there a paper issued that illustrates the patents issued in the United States? *A.*—The *Official Gazette* of the Patent Office gives exactly the information you want. By inclosing five dollars in a letter addressed Commissioner of Patents, Washington, D. C., as a subscription to the *Official Gazette*, you will receive it for one year.

(108) C. D. T., Portland, N. B., asks: 1. What power will a 3⅛ inch shaft transmit without breaking? *A.*—You do not give the number of revolutions. A rule used by some manufacturers of shafting for a safe load is: Cube the diameter of shaft, multiply by the number of revolutions, and divide by 125. If your shaft runs 100 revolutions, this would give about 34 horse-power. For line shaft others use a constant of 80, which would give 50 horse-power. It depends a great deal upon how the shaft is arranged, or whether it is a simple line shaft or a jack shaft. 2. Is not 7½ feet too great a distance apart for the journals of such a shaft? *A.*—If a simple line shaft, the journals are nearer together than it is the practice to put them. 3. How much more power will a steel shaft transmit than an iron shaft? *A.*—It ought to transmit 50 per cent. more if not exposed to shock.

(109) B., Syracuse, N. Y., asks: If salt water is first purified of all scale-forming substances, and then passed into a boiler at 40 per cent. strength, 100 being saturation and 110 strength required before depositing salt, the water or brine to pass into and out of boiler at the same strength, there being no evaporation, will the salt water cause any injury to the boiler? *A.*—We should expect that there would be some corrosion or rusting.

(110) A. M.,——, writes: Suppose I can produce an eccentric that is very simple, cheap to make, and only one is required for going ahead or backing, giving the same opening at each end, the eccentric being fast on the shaft, will it have any value? *A.*—Not much, unless it is better in some way than anything yet used for the purpose. Locomotives are at present running in which one fast eccentric on a side controls motion forward and back.

(111) J. M. C., Charleston, W. Va., writes: I have a core to make 3¼ inches wide by 5-16 inch thick, in such shape that it cannot be made in sand without changing core-box. Will a core made of plaster of paris answer as well as one made of sand? If not, what is the best plan? *A.*—Thomas D. West says: "If I knew the exact form of core-box and the position of core in the mould, I could advise more intelligently. I should not advise trying a plaster of paris core. From what I can now see, I think the best plan would be to make the change in the core-box as suggested."

(112) C. E. B., Philadelphia, asks: 1. What is the relative value of a truss, 10 feet span and 10 inches deep, and one of 10 feet span and 20 inches deep? *A.*—When both trusses or beams are the same width, and leaving the weight of the truss out of consideration, the relative value of these two trusses is as one to four. 2. How much of the total strength of the truss-rod is secured? *A.*—Before this question can be answered, it should be stated how the truss is loaded. Is it loaded at the center or not? Is it uniformly loaded? Or has it to support a moving load?

(113) G. F., Mobile, Ala., writes: 1. When the reverse lever of a locomotive is in the center notch—that is, when the block is in the center of the link—has the valve any motion, the valve having no lap and no lead? *A.*—Yes. 2. When the link is hooked up, will we obtain lead, and will this lead increase in moving towards mid-gear? *A.*—You can connect the eccentric rods to the link in a manner which will give you lead, and increase the same as the lever is moved towards mid-gear. The eccentric rods can also be connected to the link in a manner which will cause the valve to lap over the steam ports at the beginning of the stroke instead of having lead. See AMERICAN MACHINIST, sixth page, November 20, 1886.

(114) A. A. F., Mt. Olive, Ill., asks: 1. How shall I test the crank-pin of my engine to determine if it is true? *A.*—Disconnect the rod at the crosshead and bar the engine over, noting if the crosshead end moves in a line with guides. 2. If my feed pipe should burst, how can I repair it for a short time? *A.*—A crack in feed pipe may be temporarily repaired by putting a piece of rubber over the crack and winding with marlin. 3. With 60 lbs steam pressure, what would be the proper point of cut-off to bring the terminal pressure at atmosphere? *A.*—Cut off at about one-fifth stroke. 4. What is the best time to remove clinkers from brick so as to do the least injury to the walls? *A.*—When the furnace is cold, so you can go into it and work carefully.

(115) W. M., Los Angeles, Cal., asks: 1. What is the pressure on a pipe 8" diameter under a head of 250 feet of water? *A.*—108 lbs. per square inch. 2. Will a pipe of 1-16 inch iron, double-rive ted, be strong enough for this pressure? *A.*—It would undoubtedly stand the pressure, but is too thin to rivet and make tight. The metal should be ⅛ inch thick. 3. Can you refer me to some work having the conditions and requirements for an engineer in the United States Navy? *A.*—The requirements are a fair knowledge of engineering, and at the present a big "pull" with some high Government official. The school at Annapolis furnishes the most of the engineers in these times of peace, and we should not advise any one outside that to spend any time trying to get a position.

(116) L. R., Denver, Col., asks: 1. Can you tell me of some article for polishing bright work on Corliss engines? I have tried emery cloth, but it scratches. I think there is something that comes in sticks, chocolate-colored, but do not know what it is. *A.*—You doubtless refer to crocus, which you can get from any dealer in polishing materials. We do not think you will find it as good as fine emery cloth and oil. 2. I have five boilers, carrying 90 lbs. steam, and test them with 100 lbs. water pressure. Is this equal to 125 lbs. steam pressure, or are steam and water pressure the same, as far as bursting the boiler is concerned? *A.*—Steam and water pressure are practically the same. 3. What would U. S. boiler inspection call for in the way of water pressure? *A.*—Water pressure 50 per cent. higher than steam pressure allowed. For 90 lbs. steam pressure the water test would be 135 lbs.

(117) W. S., Passaic, N. J., writes: In your answer to C. F., No. 5, you say, "Cut-off is stated by the distance the piston, or, what is the same, the crosshead, has traveled." I had always understood that it was the crank angle that determined the cut-off; that is, that ¼ stroke would be at an angle of 135°. Do engine builders generally reckon the cut-off by the piston's position, and if so, why? *A.*—Stroke has to do with the linear advance of piston, and nothing to do with revolution. The reason for stating it this way is because, knowing the point of cut-off stated by the position of piston, it is easy to calculate what space has been filled with steam, and what the mean effective pressure should be. If it were stated by crank angle, the computation would be complicated. When an engine builder speaks of cut-off—for instance, at ⅛ stroke—he always means that the piston has advanced ⅛ of its stroke. If, to shorten the expression, he says cut-off ⅛, he means the same thing.

(118) W. E. C., Owatona, Minn., writes: 1. What is the highest practical velocity at which steam can be used, provided it could be used at a uniform velocity throughout the entire revolution, as if it were applied on one side of the belt, between it and the pulley on which the belt runs? *A.*—You should have given us a description of the machine in which the steam is to be used. But since steam under a pressure of 100 to 130 per square inch will flow into the atmosphere at the rate of a little over 1,900 feet per second, we believe that you can run your machine to any velocity which will be of a practical value. 2. In using steam uniformly, expansively and intermittently, as in an automatic engine, at what speed (approximately) would a loss begin to be noticeable from failure to fill out the sharp corners? *A.*—You may run the engine to any speed which is of a practical value without failure to fill out the sharp corners. 3. At this speed what should be the area of the port in proportion of the area filled? *A.*—See AMERICAN MACHINIST, page 5, Sept. 5th, 1885.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

Practical Books, Catalogue and information free. Practical Pub. Co., 5 Dey st., N. Y.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

20", 25," 28" B G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 120 built, and all successful, by David Boyle, 521 Monroe, Chicago, Ill.

Solid Nickel-Seated "Pop" Safety Valves. Con. solidated Safety Valve Co., 111 Liberty st., N. Y.

Robbs' Patent Composition for case-hardening; send for circular. F. W. Tasney, Paterson, N. J.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

Drawing materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co. 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Complete Gear-Cutting Attachment; can be fitted to any lathe from 8" to 14" swing; $40. S. M. York, Cleveland, Ohio.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Machinists' supplies, brass goods m'f'rs supplies, polishing materials, all kinds wire, metals, etc; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

Curtis Pressure Regulators, Curtis Return Trap. Curtis Damper Regulator. See Feb 5, p. 11. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

"Hints to Steam Users, Engineers and Firemen." A 100-page book on care of steam boilers; just issued; containing useful rules, tables, etc.; a valuable book for engineers; sent on receipt of 25 cts. in stamps. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

Practical Handbook on Pump Construction. Various kinds and materials to be made of for different purposes. By P. R. Bjorling. Nine plates, 12mo., $1.50. E. & F. N. Spon, publishers, 35 Murray street, New York.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES.

John McSally, of Hannibal, Mo., will establish a foundry.

Lyman Anderson, of Anniston, Ala., will erect pipe works.

The Edison shops at Schenectady, N. Y., are to be enlarged.

Meehan & Scott will soon erect a large steam forge in Chattanooga, Tenn.

The Harvard Sewing Machine Company, of Harvard, Ill., will erect a factory.

H. I. Chapman, White Pigeon, Mich., contemplates establishing a foundry.

Conway & McWilliams, Detroit, Mich., will build a foundry at 235 Sixteenth street.

It is reported that a large machine shop will be established at Blountsville, Ala.

The Union Water Meter Company, Worcester, Mass., will build a $15,000 factory.

R. E. Moore and others are interested in building a cotton factory at Columbus, Miss.

A $75 000 stock company is being organized at Charlotte, N. C., to build a cotton mill.

Another foundry is to be put in operation at Hummelston, Dauphin County, Pa., at an early day.

Chas. P. Willard & Co., Chicago, Ill., will build a one-story machine shop as an addition to their works.

Wm. E. D. Vincent will erect a factory extension at 445 West Forty-fifth street, New York, to cost $5,000.

The new blacksmith shop of the Brooks Locomotive Works at Dunkirk, N. Y., will require 1,000,000 bricks.

The Texas Pacific Railroad will add new machinery to their shops in Fort Worth and at Marshall.

It is reported that the Hartman Steel Company, of Beaver Falls, Pa., will erect steel works in Hollidaysburg.

Ingersoll & Watson, boat builders, will put up a $4,000 addition to their factory at 43 Cherry street, New York.

The Huddart Scale Company, 600 West Fifth street, Cincinnati, O., will remove its factory to St. Paul, Minn.

The S. C. Forsaith Machine Company, Manchester, N. H., will build a boiler shop as an addition to their works.

The Billings & Spencer Company, of Hartford, Conn., is now making some 6,000 pure copper drop forgings per week.

W. B. Moses & Son, of Washington, D. C., will erect a seven-story addition to their furniture factory, to cost $80,000.

J. M. Anderson, of Augusta, Ga., will erect a factory in Anniston, Ala., for the manufacture of agricultural implements.

The old Wood rolling mill at Wheatland, Pa., near Sharon, is to be converted into a pipe mill. It will employ 300 men.

It is said that an iron furnace will be built on the land of the Rome Iron, Land and Improvement Company, Rome, Ga.

The Johnson City Foundry and Machine Company, Johnson City, Tenn., will add some new machinery to their works.

Warren A. Brown and others have formed a company with a capital of $50,000, to erect a cotton factory at Gainesville, Fla.

The Birmingham Iron Bridge and Forge Company, Birmingham, Ala., ask bids for erecting buildings for their works.

Sebastian May & Co., Cincinnati, will build at Plum and Second streets, a three-story machine shop. It will be 65x50 feet.

J. W. Carter will build a foundry and machine shop at Sheffield, Ala., and wants to buy a steam boiler and engine and tools.

The construction of water-works at Emporia, Kan., has been awarded to the Holly Manufacturing Company, of Lockport, N. Y.

G. A. Kelley, Longview, Tex., has started at that place an extensive plow factory. He recently moved to that point from Jefferson, Tex.

The Diamond Wrench Company's factory at Portland, Me., is silent, and the creditors are trying to get what they can on their claims.

The Gadsden, Ala., Furnace Company—capital stock $200,000—has been organized, with L. S. Colyer as manager; will build two furnaces.

Frick & Co., Waynesboro, Pa., have purchased the Pioneer Machine Works at Covington, Ga., and will organize a stock company to operate them.

The Standard Oil Company intends, it is reported, to build a large iron mill near Oil City, Pa., for the manufacture of hoop-iron and wrought-iron pipes.

L. W. Coleman, Duncan Eve, John N. Sperry and Henry Sperry have chartered at Nashville, Tenn., the Nashville Machine Company, to manufacture machinery.

Lodge, Davis & Co., Cincinnati, Ohio, machine tool manufacturers, write us that they are running full of orders, being sold ahead for several months, and having increased their working force one-third.

The Memphis and Charleston Railroad Company (office, Memphis, Tenn) will shortly begin work on their machine shops at Sheffield, Ala., previously reported to be built.

The South Baltimore Car Works, at Baltimore, just organized by Robert Garrett and others, has $200,000 capital, and will soon erect car works that will employ several hundred men.

The Marshall (Tex.) Car Wheel and Foundry Company are enlarging their already extensive works by the construction of a new building, 75x100 feet, putting up new water-works, etc.

The Westinghouse Electric Company, of Pittsburgh, will build a new foundry and lamp shop as soon as the weather will permit. It will increase their output of lamps from 4,000 a day to 8,000.

Land has been purchased by the Santa Fe Railroad Company at Topeka, Kan., and the construction of machine shops to build and repair locomotives will commence as soon as the weather permits.

E. Scott and associates have had a site on Chattanooga Creek, Chattanooga, Tenn., donated to them, and as soon as they can get railroad connections they propose to build a foundry and steam forge and to manufacture nuts and bolts.

Wm. Tod & Co., Youngstown, O., have issued a well-illustrated and artistically-printed pamphlet descriptive of the Porter-Hamilton engine built by them. Details of the engine are shown, and some of the names of purchasers are appended.

One of our old subscribers, W. P. Cowan, 52 Handen road, Lee, London, England, formerly in mechanical charge of a large locomotive works in Scotland, has gone into the laundry business, and writes us that he intends to "put in some American machinery."

The Damascus Edge Tool Corporation was organized at Louisville, Ky., February 15th. Charles Godshaw, president. The capital stock is $1,500,000. They claim to have a secret and wonderful process for hardening and tempering steel; also for converting iron into steel.

The contract for erecting three furnaces for the Alabama and Tennessee Coal and Iron Company, at Sheffield, Ala., has been awarded to Gordon, Strobel & Laureau, of Philadelphia, the first to be completed in thirteen months, the second in fifteen months, and the third in seventeen months.

The Arms-Bell Company, of Youngstown, O., has been incorporated to manufacture bolts, nuts, etc. Capital stock, $50,000. Myron C. Wick, Wm. H. Baldwin, Thomas H. Wilson, Myron E. Dennison and John H. Clark, corporators. This company succeeds to the old business of Arms, Bell & Co.

The Chicago and Eastern Illinois Railroad Company has just given an order to the Hinkley Locomotive Works, of Boston, for nine new heavy locomotives, made necessary by increasing business. The Hinkley works are also building fifteen new locomotives for the Atchison, Topeka and Santa Fe.

The St. Louis *Age of Steel* says: "The machine tool trade is reported rather slack among the large houses on Main and Third streets. A great many inquiries are coming to hand, but somehow they result in few sales. Probably half the people who write for catalogues and prices haven't the money to buy the tools they desire."

The Etowah Iron and Manganese Company, Atlanta, Ga., reported last week as incorporated at Atlanta, Ga., by J. W. Rankin and others, and to spend from $500,000 to $600,000 in developing their property near Cartersville, will build a large steel rail mill, to cost about $1,000,000. They will build two chemical charcoal furnaces in addition to the two furnaces reported last week.—*Baltimore Manufacturers' Record.*

At the next annual town meeting in Harwich, Mass., the town will act on an article in the warrant to see if the town will vote to build a boot and shoe factory that will accommodate 300 operatives, and offer it rent free for ten years to any responsible manufacturer having an established business, who will employ 200 of the townspeople during the decade, and also to see if the town will appropriate $10,000 for the purpose.

The new "Union Machine Company," of Fitchburg, Mass., was recently organized with the following officers: President, John Burney; secretary, Emmons Crocker; treasurer, S. E. Crocker; directors, John Burney, T. C. Crocker, S. E. Crocker, George F. Fay, George H. Crocker, Alvah Crocker. The company, which manufactures general paper mill machinery, is quite busy, and the men have been working extra hours.

A special dispatch from Harrisburg, Pa., dated February 19th, says: "The prosperous condition of the iron trade of the country at the present time is well indicated by the orders that are pouring in upon the Pennsylvania Steel Company's Bessemer Steel Works near this city. The furnaces and mills, which are of the largest capacity, employing 5,000 men, are running night and day. The open hearth furnaces have been at work on special steel orders all the past week. One roller in No. 1 Mill made a run of 446 tons of finished blooms on Thursday, the largest on record. The steel rail mills are running on exceptionally heavy orders. In one turn of eight hours, on Tuesday, 299½ tons of rails were made, the largest production ever known in that time. A turn of twelve hours produced 400 tons. The steel pinion works are exceeding all previous records in their product. The frog and switch works are pressed beyond their capacity. The orders come chiefly from the South and West.

Machinists' Supplies and Iron.

New York, Feb. 24, 1887.

Iron—There is only a moderate demand for American pig to meet current wants, but the demand so nearly covers production as to make the maintenance of prices easy. No. 1 X Foundry sells at $21 to $21.50; No. 2 X, $20 to $20.50; Grey Forge, $18.50 to $19.

Scotch Pig—Quotations are unchanged, at Coltness, $23 to $23.50; Gartsherrie, $22 to $22.50; Eglinton, $21 to $21.50; Langloan, $22 to $22.50; Dalmellington, $21 to $21.50.

Lead—Small transactions have occurred at 4.40c.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Position wanted as machine shop supt., by a capable man. Address C. L., Am. Machinist.

Wanted—Situation as foreman patternmaker; good reference. Address S. B., Am. Machinist.

A traveling salesman is open for engagement; is a practical machinist and engineer. Address C., Am. Machinist.

Wanted—Position as asst. superintendent in steam pump works, or to erect water-works machinery outside; first-class record. Address E. N. G., Am. Machinist.

Wanted—Six first-class machinists to work on the manufacture of steam engines, by Ottumwa Iron Works, Ottumwa, Iowa.

A first-class pract. and theoret. draftsman and engineer wants position; can take charge of drawing room. Address M. E. & D., Am. Machinist.

Electro, gold, silver, nickel and bronze-plater wants situation in any part of the United States; 22 years' experience. Box 10, Oakville, Conn.

Wanted—An expert draftsman (Swede or American), a graduate of a polytechnic school. Address, giving age and experience, P. O. Box 1034, Worcester, Mass.

Wanted—Position as foreman boilermaker by practical mechanic, who has been foreman a number of years; will give reference as to ability, etc. Address J. W. T., Am. Machinist.

Wanted—By a practical die sinker and tool-maker and drop forge worker, a position as foreman or superintendent; best of references given. Address Expert, Am. Machinist.

Wanted—Two good machinists; quick, accurate at milling and filling engine connecting rods as a specialty; good wages; steady work to the right men. Address Wm. E. Leard, New Brighton, Pa.

Wanted—By a good, practical machinist, a position as foreman, or would take charge of machine department in large manufactory; references furnished. Machinist, P. O. Box 380, Worcester, Mass.

Wanted—Competent foreman to take charge of a machine shop employing fifty men on the general work of this State; write, stating age, previous experience, references, and salary expected. Address applications to Box K, Muskegon, Mich.

Wanted—Situation by a practical machinist accustomed to marine and stationary engine work in all its branches, general jobbing and use of indicator; New York, east or south, preferred. Address J. S., Am. Machinist.

Position wanted as assistant supt. or assistant manager, by a young, active and well-educated man, with good experience regarding steam engines, tools and special machy.; good references. Address L. L., Am. Machinist.

Wanted—Situation by a draftsman, with good experience in stationary and marine engines (compd. and triple exp.), mining and refrigerating machinery, etc.; first-class references. Address T. E., Am. Machinst.

Wanted Position as draftsman, by a young man (26), graduate of a technical school; 4 years' experience in machine shop and 5 in drafting room on regular and special machinery; references from present employer. Address A, Am. Mach.

Machinery salesman wanted, by a house desiring a representative in New York; must be well posted in engines, water tubes and other steam boilers, and general mill machinery; a mechanical engineer preferred. A similar agent desired for Boston. Address, stating qualifications and terms desired, Box 11, Am. Machinist.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Gerlach's Engineers' Specialties beat the world. Send for price list. Crescent Mfg. Co., Cleveland, O.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

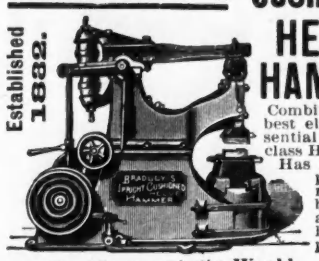
For Sale—One 1¼" Merriman bolt-cutter, one 20" swing, 12 ft. bed, engine lathe, both new. The McLagon Foundry Co., New Haven, Ct.

For Sale—Perfect patterns and full shop drawings for 8, 10 and 12 H.P. farm engines; most popular style; large number in use; owner in other business. James W. See, Consulting Engineer, Hamilton, Ohio.

Lag screws, nuts and washers, wrenches, hammers, taps, dies, screw plates, pipe tools, and variety of machinists' tools and supplies, new and in good condition, will be sold low. Frank K. Tyler, Summerfield, Md.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

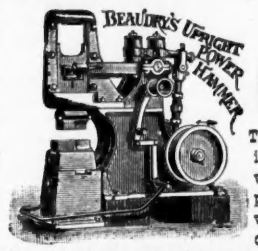
Established 1832.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

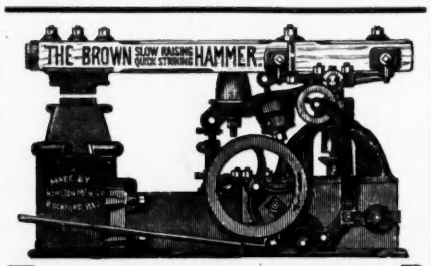
BRADLEY & CO. Syracuse, N.Y.

BEAUDRY'S UPRIGHT CUSHIONED POWER HAMMER



The success of our machine is the best guarantee of its value. Only hammer with patent Duplex Steel Helve which never rattles, burns or breaks. Guaranteed to do more and better work with less repairs than any other.

BEAUDRY & CUNNINGHAM, Boston, Mass.



THE BROWN HAMMER STRIKES A BLOW WITH

Double the Velocity That it Raises the Hammer

A NEW MOVEMENT! SEND FOR DESCRIPTION

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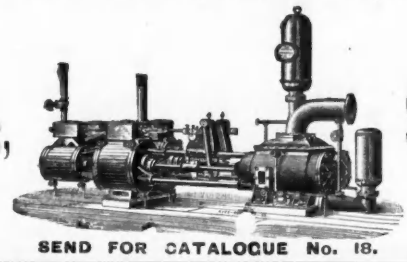

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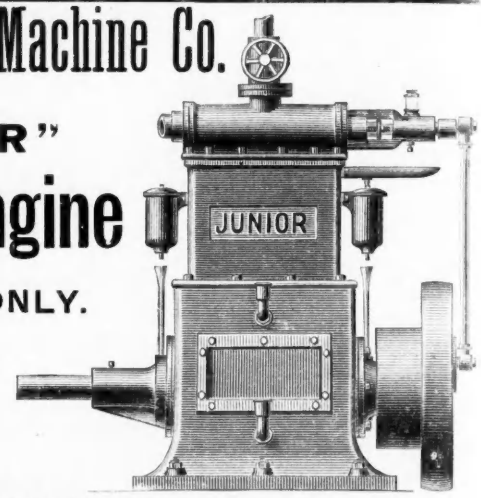

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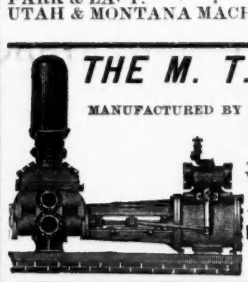

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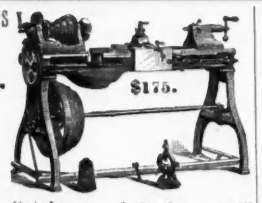

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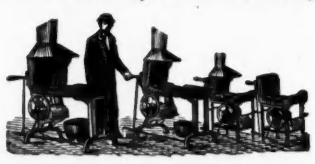

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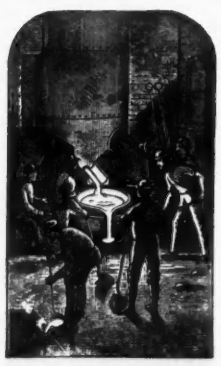

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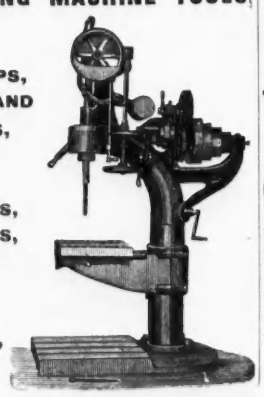

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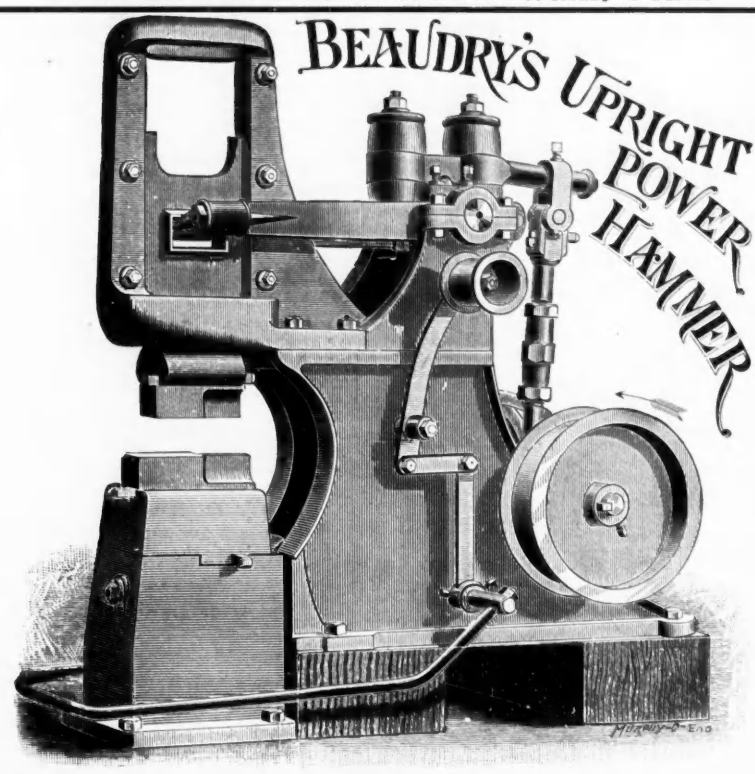

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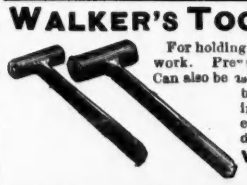

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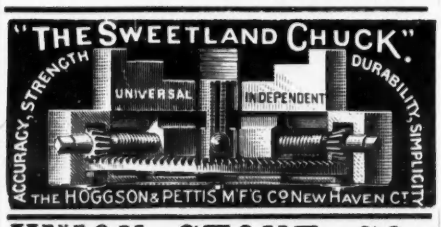

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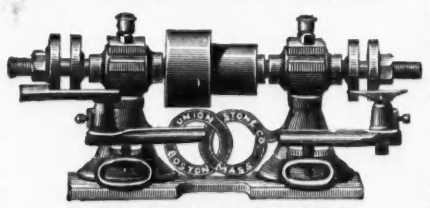

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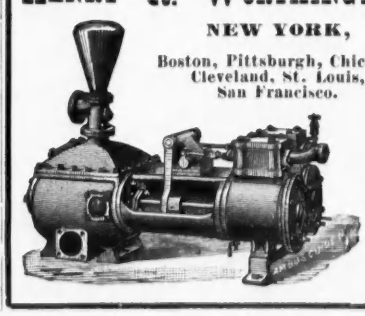

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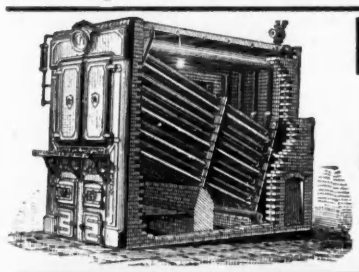

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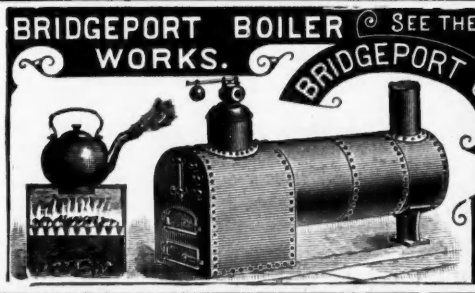

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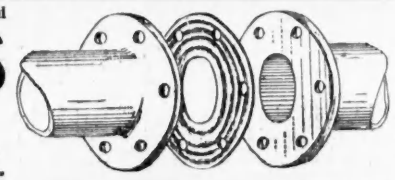

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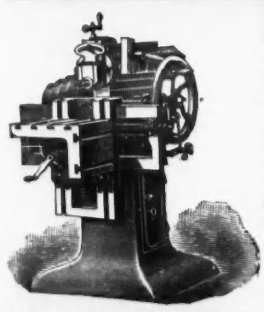

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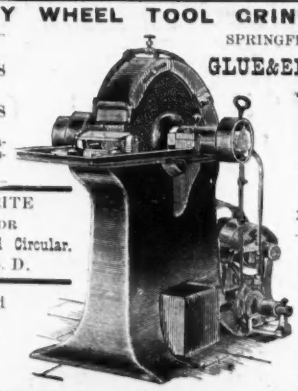

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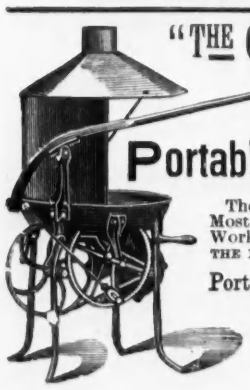

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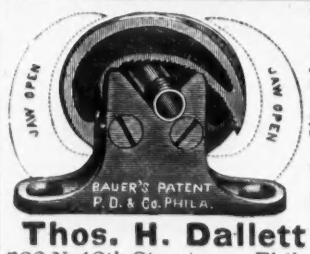

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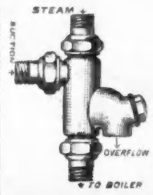

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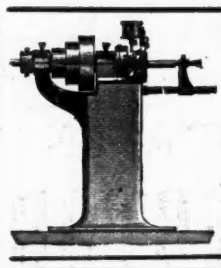

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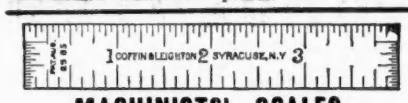

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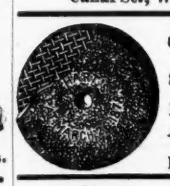

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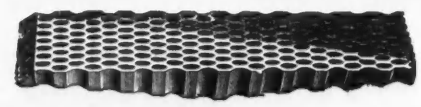

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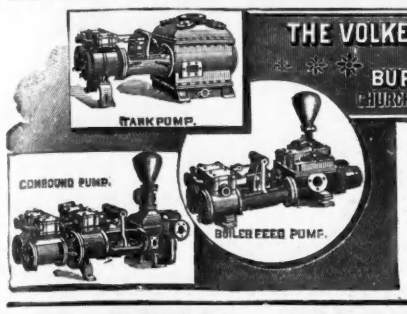

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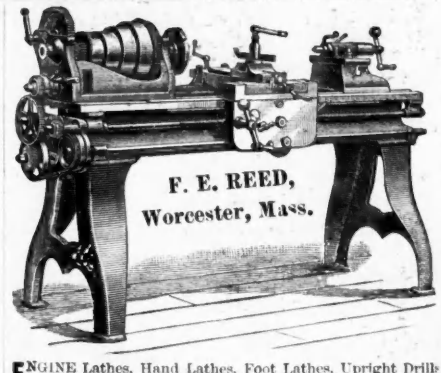

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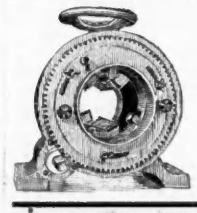

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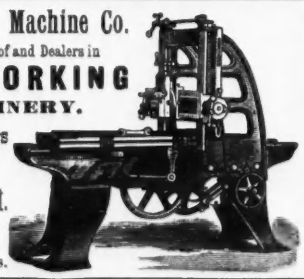

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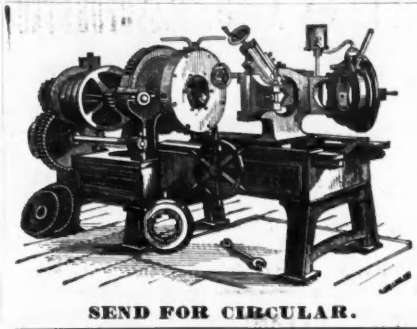

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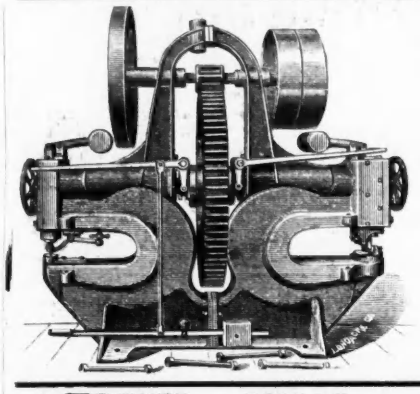

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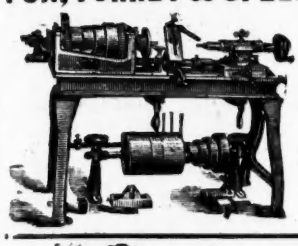

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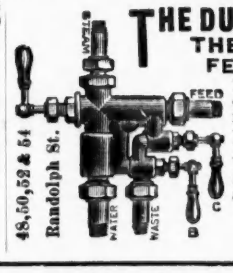

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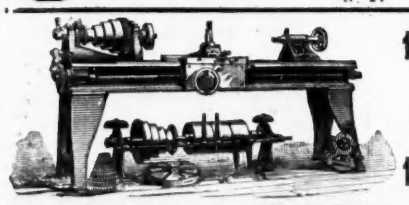

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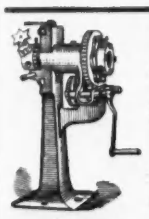

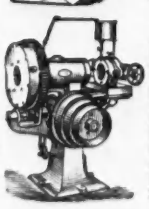

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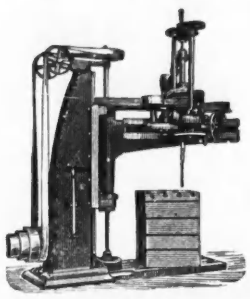

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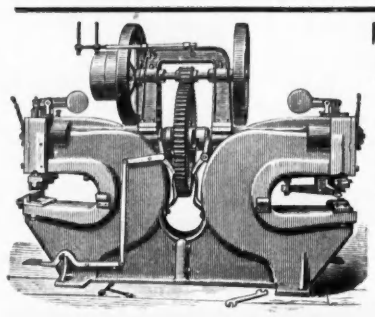

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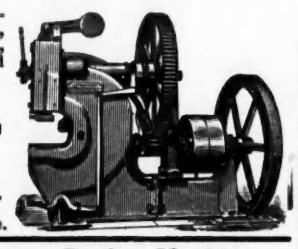

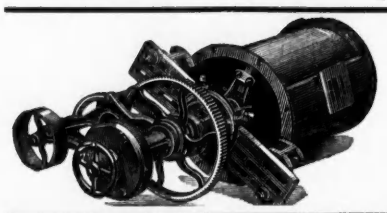

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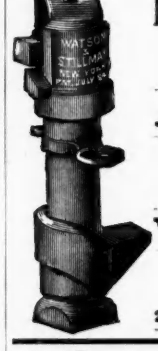

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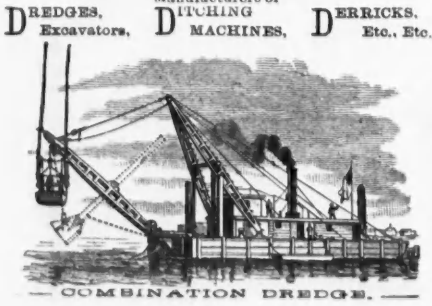

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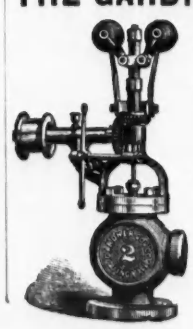

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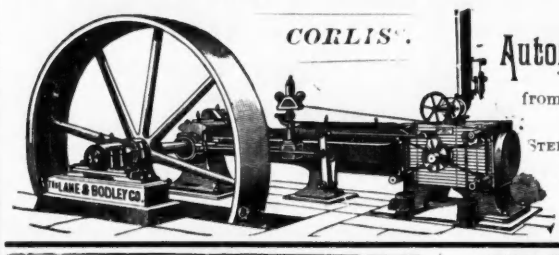

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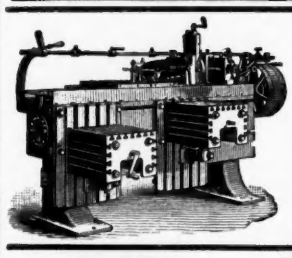

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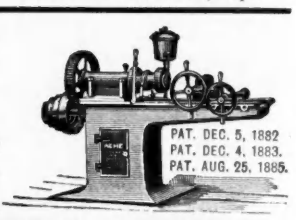

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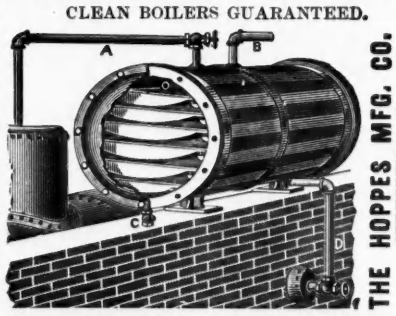

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"	30	" Portable " new.			
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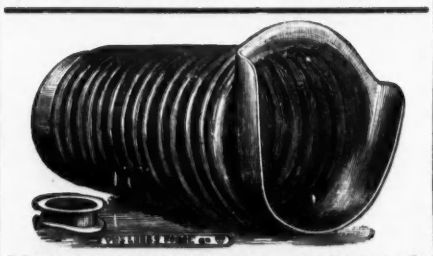

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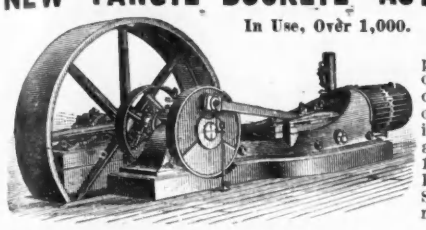

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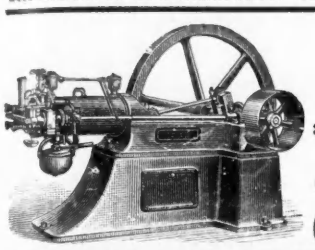

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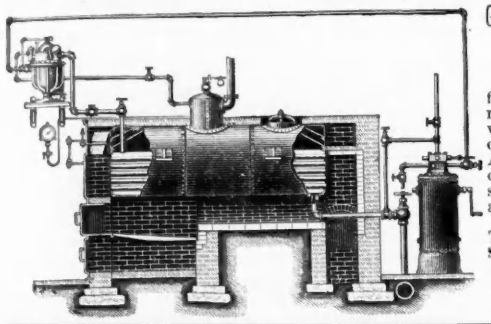

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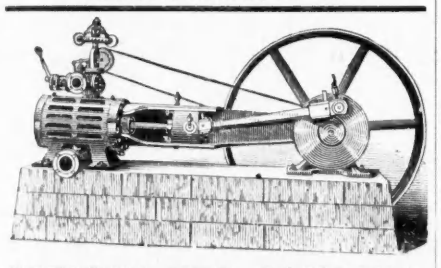

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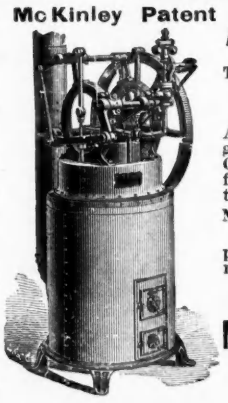

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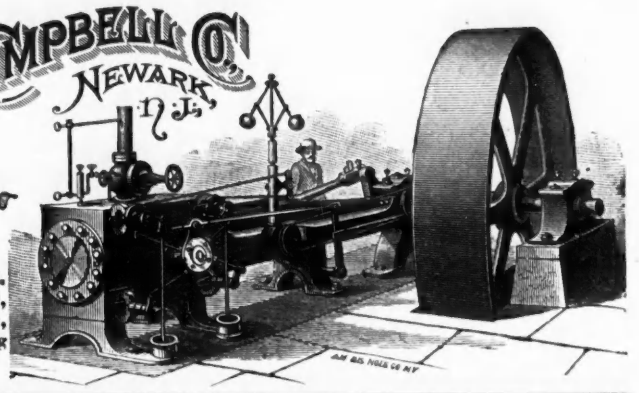

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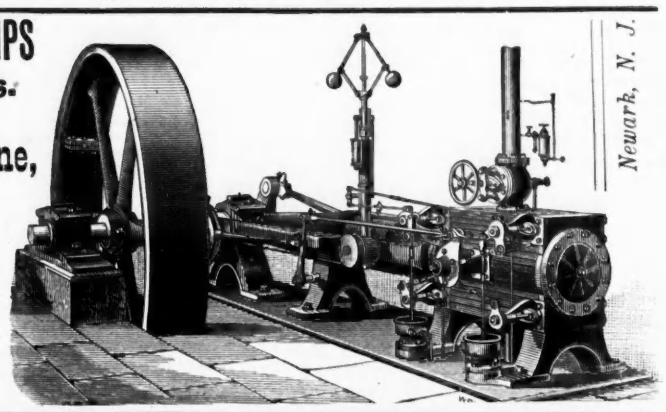

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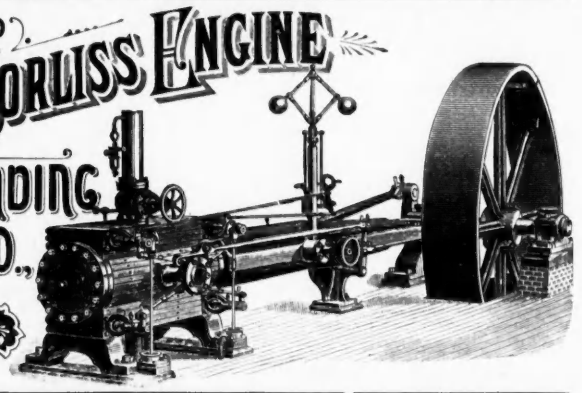

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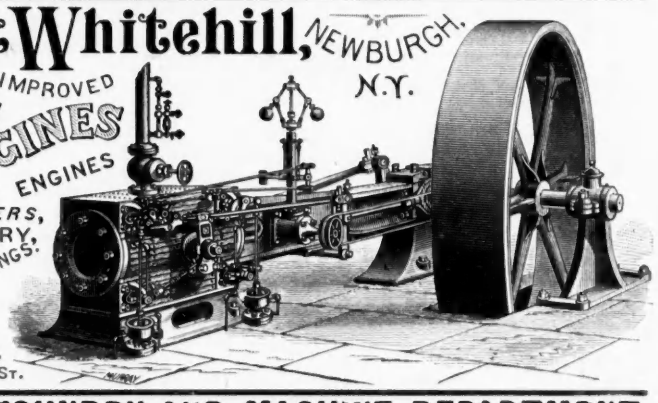

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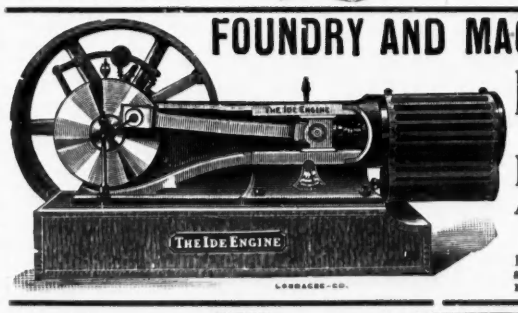

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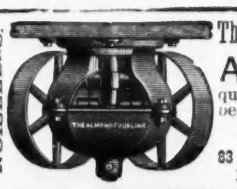

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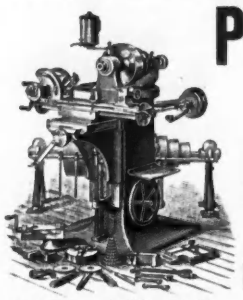

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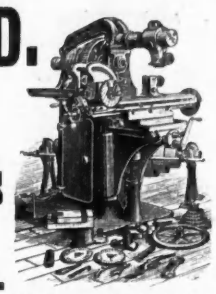

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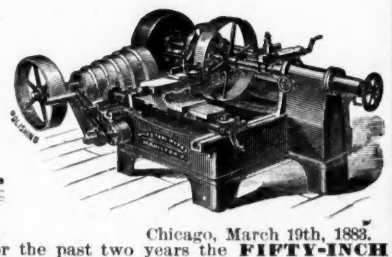

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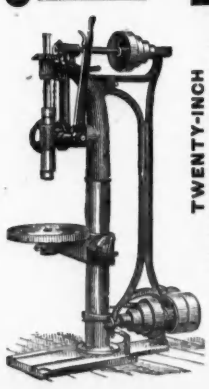

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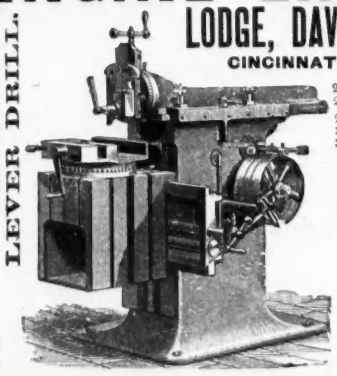

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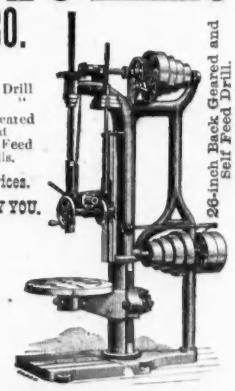

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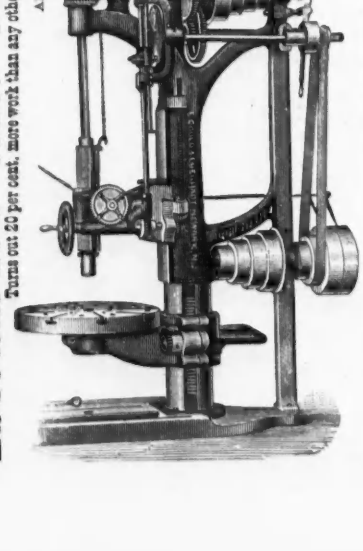

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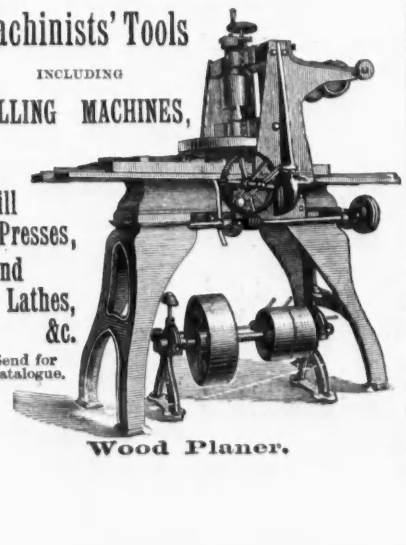

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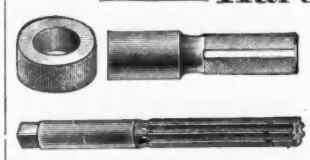

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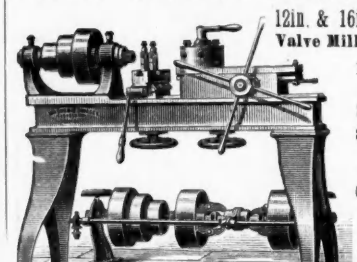

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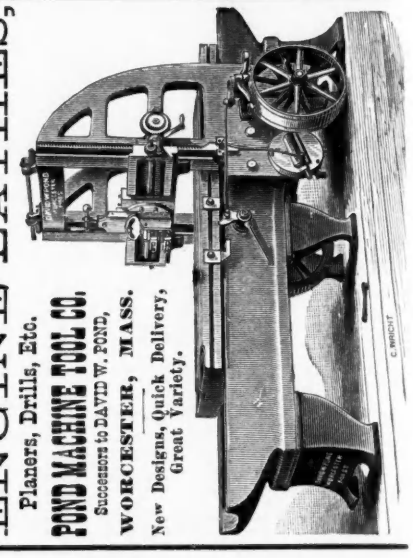

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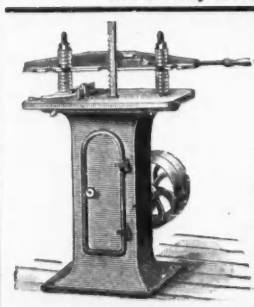

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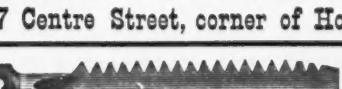

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